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010948

SOURCE CONTROL FEASIBILITY STUDY

SHERIDAN DISPOSAL SERVICES SITE
WALLER COUNTY, TEXAS

VOLUME I

Prepared for:

The Sheridan Site Committee

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W.O. #91-01

Prepared by:

ERM-SOUTHWEST, INC.
16000 Memorial Drive, Suite 200
Houston, Texas 77079
(713) 496-9600

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EXECUTIVE SUMMARY

The Sheridan Site Committee has investigated the Sheridan Disposal Services site near Hempstead, Texas. The ultimate objective of the Feasibility Study is to provide a basis for selecting a cost effective remedial alternative that is protective of human health and the environment. The alternatives constructed and evaluated are designed to meet this and other remedial objectives as well as attain Federal and State requirements that are applicable or relevant and appropriate (ARARs). The investigation and evaluation of this site have been divided into a source control effort and a ground water migration management effort. The source control effort has resulted in a Source Control Remedial Investigation and this document, the Source Control Feasibility Study.

The facility currently occupies approximately 110 acres and includes a 42 acre evaporation system, a main pond whose surface area varies from 12 to 15 acres (depending on water level), and a 17 acre dike area around the main pond. An inoperable incinerator and a group of nine treatment and storage tanks are located on the east side of the main pond on the levee. Remaining acreage consists of borrow ditches excavated for the dikes and other "buffer zone" areas inside the perimeter fence.

Following site characterization, source control technologies were screened from possible general response actions and assembled into alternatives. These alternatives underwent detailed design analysis, including sufficient design development to enable a detailed cost estimate to be prepared. The following six alternatives survived the screening process and were carried forward into the detailed analysis phase:

- Take no action at the site.

- Mix the main pond sludge with clay-rich soil and cover the main pond and dikes with an engineered cap. Protect the site from river bank erosion and soil erosion.

- Stabilize the sludge within the main pond. Cap and control erosion as above.

- Biologically treat the sludge. Cap and control erosion as above.

- Separate the sludge into oil, water and solids fractions and incinerate the oil fraction. Cap and control erosion as above.

- Incinerate the sludge in a rotary kiln incinerator. Cap and control erosion as above.

In the detailed alternative analysis phase, each of these alternatives was ranked based on relative compliance with ARARs; reduction of toxicity, mobility or volume; short term effectiveness; long term effectiveness and permanence; implementability; cost; acceptability to the community; acceptability to the State; and overall protection of human health and the environment. Based on this detailed evaluation it will be possible to select a cost effective remedial alternative consistent with the objectives outlined above.

SOURCE CONTROL FEASIBILITY STUDY

SHERIDAN DISPOSAL SERVICES SITE
WALLER COUNTY, TEXAS

1 - INTRODUCTION

1.1 Purpose and Scope

The purpose of this Source Control Feasibility Study (FS) is to present the process and results of the development of the source control remedial alternatives for the Sheridan Disposal Services (SDS) site. This FS is based on the information and data presented in the July 1987 Source Control Remedial Investigation (RI) by the Sheridan Site Committee (SSC) and the June 1988 Baseline Risk Assessment (RA). The RI defined the character of the site and the RA addressed the necessity of remediation by evaluating risks represented by taking no action. By addressing the risks identified in the RA, the FS alternatives will be protective of human health and the environment.

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The FS identifies and analyzes source control alternatives that are consistent with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA), and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), and which effectively mitigate and minimize threats to, and provide adequate protection of, public health and welfare and the environment at the site.

1.2 Site History

1.2.1 Geographical Location

The SDS site is located in Waller County, Texas, approximately nine miles north-northwest of the City of Hempstead, Texas and two miles northwest of the intersection of Clark Bottom Road and Farm Road 1736 (Fig. 1-1). The property is bounded on the east, south and west sides by farm and ranch lands, and on the north by the Brazos River. The site lies within the Gulf Coastal Plain Physiographic Province and is transitionally positioned between the Post Oak Savannah and Blackland Prairie Natural Regions of Texas.

1.2.2 Facility Description

The facility currently occupies approximately 110 acres, and includes a 42 acre evaporation system, a 15 acre main pond and a

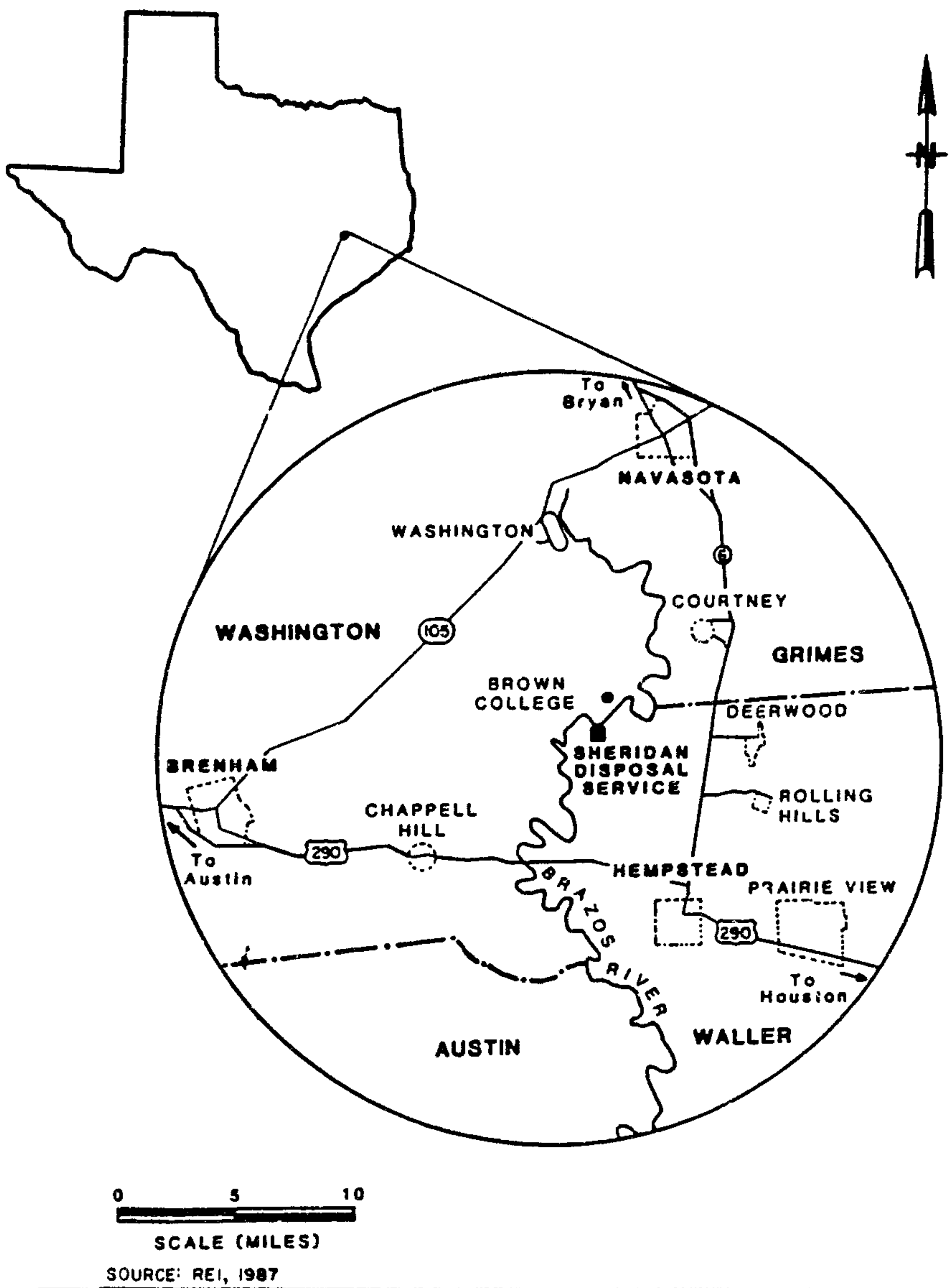

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FIGURE 1-1
SITE LOCATION MAP
SHERIDAN DISPOSAL SERVICE

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17 acre dike area around the main pond (Figure 1-2). An inoperable incinerator and a group of nine treatment and storage tanks are located on the east side of the main pond on the levee. Remaining acreage consists of borrow ditches excavated for the dikes and other "buffer zone" areas inside the perimeter fence.

The main pond was located in a naturally occurring, low-lying area that was gradually expanded to about 22 acres utilizing a system of dikes. The main pond was used as a surface impoundment for material disposal and for open pit burning. Partial closure activity reduced the size of the main pond to approximately 15 acres.

Water that accumulated in the main pond due to precipitation was pumped into the evaporation system and allowed to evaporate. The tanks were used for the separation and treatment of incoming liquid waste.

1.2.3 Chronological History of Site Management, Use and Modifications

The SDS site, owned and operated by Mr. Duane Sheridan of Hempstead, Texas, began accepting industrial wastes for disposal in the late 1950s. These wastes were disposed of by open pit burning and surface impoundment of ash residue in a naturally low-lying area of Mr. Sheridan's property. As the volume of material accepted at the site increased, a levee composed of native soils and combustion residuals from waste burning was constructed around the pit area to form the main pond (sometime in late 1963). These site management practices and facilities were used through 1971.

A group of storage and treatment tanks were constructed beginning in September 1971 in response to an order from the Texas Water Quality Board (TWQB), a predecessor to the Texas Water Commission (TWC). These tanks were used for steam treating oil-water emulsions. Separated oils were used as fuel for a system of ground flares that was installed in 1972.

A smaller pond (approximately 400,000 gallons) was constructed in the northwest corner of the main pond dike (Figure 1-2). It was used to receive incoming materials. From there the waste was generally pumped into the steam treatment system for emulsion treatment. Any recovered oils were either sold or used for ground flares or boiler feed to generate steam. Leftover residues were disposed of in the main pond. Liquid wastes from the smaller pond were discharged directly into the main pond when the steam emulsion system was not working or was over-loaded.

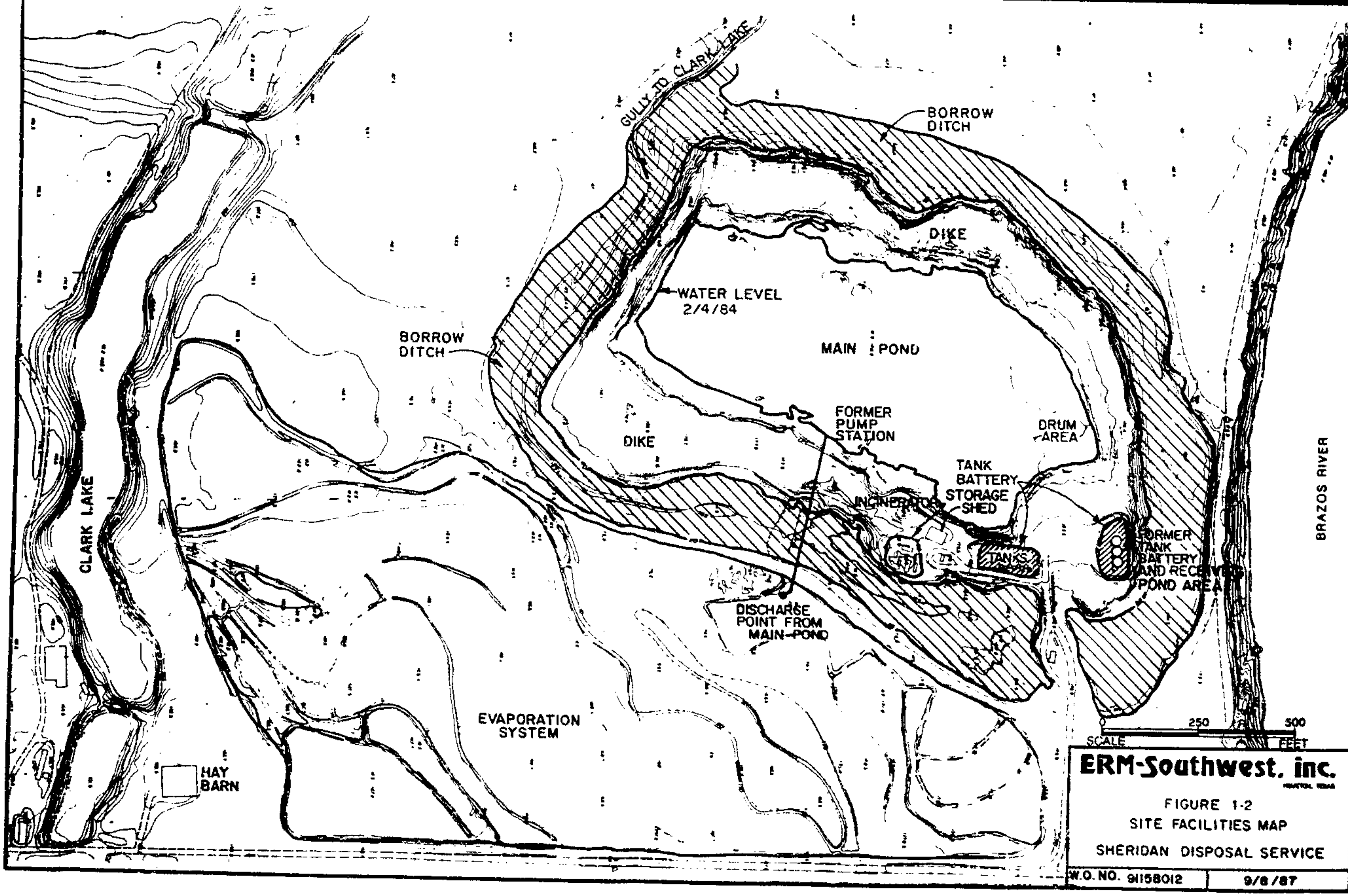

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FIGURE 1-2
SITE FACILITIES MAP
SHERIDAN DISPOSAL SERVICE

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In November of 1972 a fire destroyed the oil burner (incinerator) system and the surface of the main pond was ignited, burning off the surface layer of oil. In 1969 and 1973 severe rainfall caused apparent overflows. The height of the dike was increased in 1975 to mitigate this occurrence.

During 1974 and 1975, several trial burns of new incinerators were performed by SDS. Permit approval was granted to SDS by the Texas Air Control Board (TACB) for a liquid waste burner (incinerator) that was designed and built by Mr. Sheridan. The incinerator was in use until June 1978 when a fire destroyed portions of the system.

In order to take care of the continuing problem of accumulated pond stormwater, a new facility -- the evaporation system -- was built in 1976 adjacent to the main pond. This 42 acre impoundment received wastewater from the main pond into a series of small cells where it was allowed to evaporate.

SDS began closing the main pond with dike and other materials in October 1978. An initial closure plan was agreed to by SDS and the TWQB in 1979. This plan called for initial closure of the main pond, pumping of accumulated stormwater from the pond into the evaporation system, and maintenance of the pond dike. Pond water was transferred to the evaporation system and approximately seven acres of the main pond, corresponding to the receiving basin, was covered with fill material.

A final closure plan was submitted to the Texas Department of Water Resources (TDWR, now the TWC), by SDS on December 2, 1983. It was rejected in January 1984, at which time the TDWR determined that SDS did not have the expertise or resources to properly close the site. At that time the TWC contacted certain companies, whose waste may have been disposed of at the SDS site, to request assistance in the site closure. The SSC was formed by certain of those companies in response to that request and has since worked with the TWC and the EPA to collect and analyze information necessary to evaluate appropriate closure alternatives.

The SDS site was proposed for inclusion on the National Priorities List pursuant to Section 105 of CERCLA on June 10, 1986.

1.3 Source Material Description

The major sources of organic and inorganic chemical constituents are the main pond water and sludges. There may be additional quantities of affected sludges and soils below the pond, in the dike and in the evaporation system. These sources are described below. Manifest descriptions of some of the materials received for disposal at the site are listed in Table 1-1. Summaries of organic compounds and metals found in all sources are presented in Table 1-2 (footnotes and references in the table relate to the Baseline Risk Assessment). Based on the RA, the polychlorinated biphenyl (PCB) concentrations in the exposed sludges (which averaged 159 ppm for the pond sludge) drive the determination of remedial action levels for the site.

Main Pond

The current surface area of the main pond varies between 12 and 15 acres. The depth of the accumulated rainwater varies between one and six feet during periods of accumulation and removal.

The main pond contents are stratified into a partial surface oil and emulsion layer, an aqueous phase and a heavy sludge layer. The surface oil layer (less than two inches in thickness) currently covers less than 15% of the pond surface and varies depending on wind conditions. At the present time, the majority of the oil layer has been removed from the main pond and the main pond water has been evaporated in the evaporation system in accordance with an Administrative Order issued by the EPA.

Based on results from the analysis of 15 samples collected in June 1987, the main pond sludges vary in thickness from about six inches to about 24 inches, with an average thickness of 12.4 inches. These sludges are approximately 45% water, 40% oil, and 15% solids, by weight. This depth contrasts with sludge thickness measurements of one foot to just over three feet in September 1984 (see Appendix A of RA). An average pond depth of 18 inches is used for risk and design calculations.

No samples of pond subsoil were collected during the RI investigations due to the possibility of carry down of affected material contained in the sludge.

Pond Dike

The dike around the pond has a surface area of approximately 17 acres and was constructed primarily from surrounding clays and combustion residues from the incinerator. It is estimated that up to 10% of the levee material may consist of materials characterized as diatomaceous earth filter aid wetted with a petroleum oil. This filter cake material contains unspecified organometallic chemicals as well as insoluble barium and zinc salts.

TABLE 1-1

Descriptions of Materials Listed on Manifests for Disposal at the SDS Site

Alcohol, organic phosphorus compounds, cobalt

Alkyl Benzenes

Ammonia Bromate, Water

Barge, RR Tank Car Washings, & Misc. Chemicals

Benzene, Ethers, Methychloride

Butyl Acrylates

Calcium Arsenate

Caustic and Latex Polymer

Copper Chloride Powder Catalyst

Diethylene Glycol, Resin, w/Toluene

Drilling Muds

Drum Washing Residue

Fatty Acid Esters

Fatty Alcohols

Filter Cake Residue

Furfural, Butadiene Copolymer

Glycol Still Bottoms

Herbicides

Hydraulic Oils

Insecticides

B, S & W Oils

Kerosene & Grease

Kitchen Grease & Water

Methacrylate

Molasses & Water

Oily Wastewater

Organic Sludge, Skimming, Kerosene and Mineral Spirits

Phenol Formaldehyde

Pickling Acid

Polyethylene, Diatoamaceous Earth

Process Wastewater

Soap

Sodium

Sodium Hydroxide

Sour Crude Oil

Spent Chlorinated Solvents

Spent Newspaper Inks and Solvents

Styrene & Ethylbenzene Bottom

Styrene Monomer w/Diesel

Vegetable Oils

Waste Chemicals

Water & Oil

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TABLE 1-2

Summary of Representative Concentrations and Volumes for
Specific Waste Compartments and Receptors for the Sheridan Disposal Services Site

Parameter	Representative Water Concentrations (1): Main Pond Water (2) (Table 4-1&2)	Representative Water Concentrations (1): Clark Lake Water (West end) (Table 8-7)	Brazos River Water Quality (Table 8-4)	Representative Concentrations for Soils/Sludges (1): Main Pond Sludges (2)	Dike Area: Averaged Soils (3)	Dike Area: Affected Soil	Evaporation Area: Soils	Evaporation Area: Sludges (2)	Background Soils (Tables 4-1&2)
Units	mg/l	mg/l	mg/l	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Area (acres)	19 (4)		Surficial	12	17	12	40.75	0.25	Surficial
Representative thickness (feet)	7.1 (5)		NA	1.5	11	5.5	0.5	0.5	NA
Approximate volume (cu.yds.)	217021		NA	30000	301693	114000	33000	200	NA
Density	1.0 g/cm3	1.0 g/cm3	1.0 g/cm3	1.1 g/cm3	1.6 g/cm3	1.3 g/cm3	1.6 g/cm3	1.3 g/cm3	1.6 g/cm3
Benzene	ND	ND	ND	1050	12	23	ND	42.95	ND
2,4-Dimethylphenol	ND	ND	ND	342	8	16	ND	24.7	ND
Ethylbenzene	ND	ND	ND	3267	6	11	ND	301	ND
Naphthalene	ND	ND	ND	257	6	12	ND	ND	0.135
Total PCBs (as Aroclor 1016)	ND	ND	ND	159	10	19	ND (6)	25	ND
Phenol	1.8	ND	ND	695	45	90	ND	757	ND
Tetrachloroethylene	0.26	ND	ND	121	ND	ND	ND	21.8	ND
Toluene	0.63	ND	ND	1225	10	19	ND	165.0	ND
Trichloroethylene	1.46	ND	ND	50	ND	ND	ND	ND	ND
Metals (as total constituent)									
Chromium	1.14	0.01	0.01	236	13	20	33.4	72.6	31.1
Lead	0.304	0.012	0.0235	404	149	290	45.7	164	11.6
Nickel	0.625	ND	0.005	67	12	14	17.6	31.5	17.2
Zinc	4.505	0.07	0.035	573	285	492	72.6	751	39.6

(1) Except for sludge samples, the representative concentration given is the average of [detected concentration(s) plus 1/2*(sample d.1.)] found for the waste compartment indicated.

(2) Representative values for sludge samples are calculated as the average of all above-detection-limit concentrations or 1/2 of detected value if there is only one detection in the data base. See Appendix E-1 for documentation. These calculations provide worst-case levels for direct contact exposure and ground water models. Representative values for Toluene and Zinc to not include outlier values of 36,600 and 13,800 mg/Kg, respectively, because concentrations of that magnitude were not confirmed in 1987 samples.

(3) Average dike soil concentration is calculated as the mean of all visually affected and unaffected soils data from the dike boring samples collected July 6-10, 1987 (see Appendix E-1 for documentation). These calculations provide data for dust emissions and direct exposure models.

(4) Acreage given is based on the assumption that, if abandoned, the pond would fill to an elevation of 176.5 feet MSL and would decant over the lowest part of the dike at that elevation with each subsequent rainfall. The low point appears to be located on the north dike, west of the former tank battery and receiving pond (Figure 2-2).

(5) Depth given is based on the average depth (3.6 feet) from the water surface to the sludge surface (see Table 3-5) as recorded in the June 17-18, 1987 sampling of pond sludges, plus the difference between the water elevation recorded on that date (173' MSL) and 176.5' MSL (a difference of 3.5').

(6) PCBs (as Aroclor 1248) were detected from 0.5-1' depth in evaporation system cells 3 and 15 at concentrations of 1600 ug/kg and 110 ug/kg, respectively (samples from February 1988 and December 1987 sampling events).

A series of borings were made through the depth of the dike to confirm its construction and to characterize soils and waste materials within it. Figure 1-3 shows the locations of these borings. Appendix A contains the boring logs and summary tables for the organic and inorganic analytical results. The boring logs indicate that affected soil and sludge in the dikes is typically not encountered until depths in excess of three feet.

SDS began initial closure actions in 1979. Approximately five acres of the pond in the northern section were covered with construction debris and dike material. In an earlier pond closure effort (not completed), another two acres of the south-eastern portion of the pond were capped using apparently clean fill materials and on-site soils. (These seven acres are included in the estimated dike area of 17 acres.)

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Evaporation Area Sludges and Soils

The evaporation system consists of 42 acres of water retention cells. The majority of organic compounds that were identified in the evaporation system occur in isolated sludge deposits at or near the point of pond discharge into the evaporation system. Based on samples collected in June 1987 and December 1987, the remainder of the evaporation system contains soils that are generally characteristic of background soils in the area. Metal concentrations were generally in the same range as background and no volatile or semi-volatile compounds were identified. PCBs at concentrations of 1600 and 110 ug/kg (ppb) were identified at two of nineteen sample locations. PCBs were not detected in seventeen of the nineteen evaporation system soil sampling locations (Appendix A of FS).

Process Tankage

Treatment process units at the SDS site are located on the top of the levee and include an incinerator, a boiler, and nine tanks. The tanks were used for separation and treatment of oil/water emulsions and storage of solvents and fuel oils. The tanks vary in size from 500 to 1000 barrels in capacity. The tanks presently contain approximately 1500 bbl of oil and emulsion removed from the surface of the pond.

1.4 Methodology

The methodology used in this FS report allows a step-by-step evaluation of source control remedial technologies, alternatives, and assembled alternatives by progressing through a series of screening steps (see Table 1-3). Initially, general

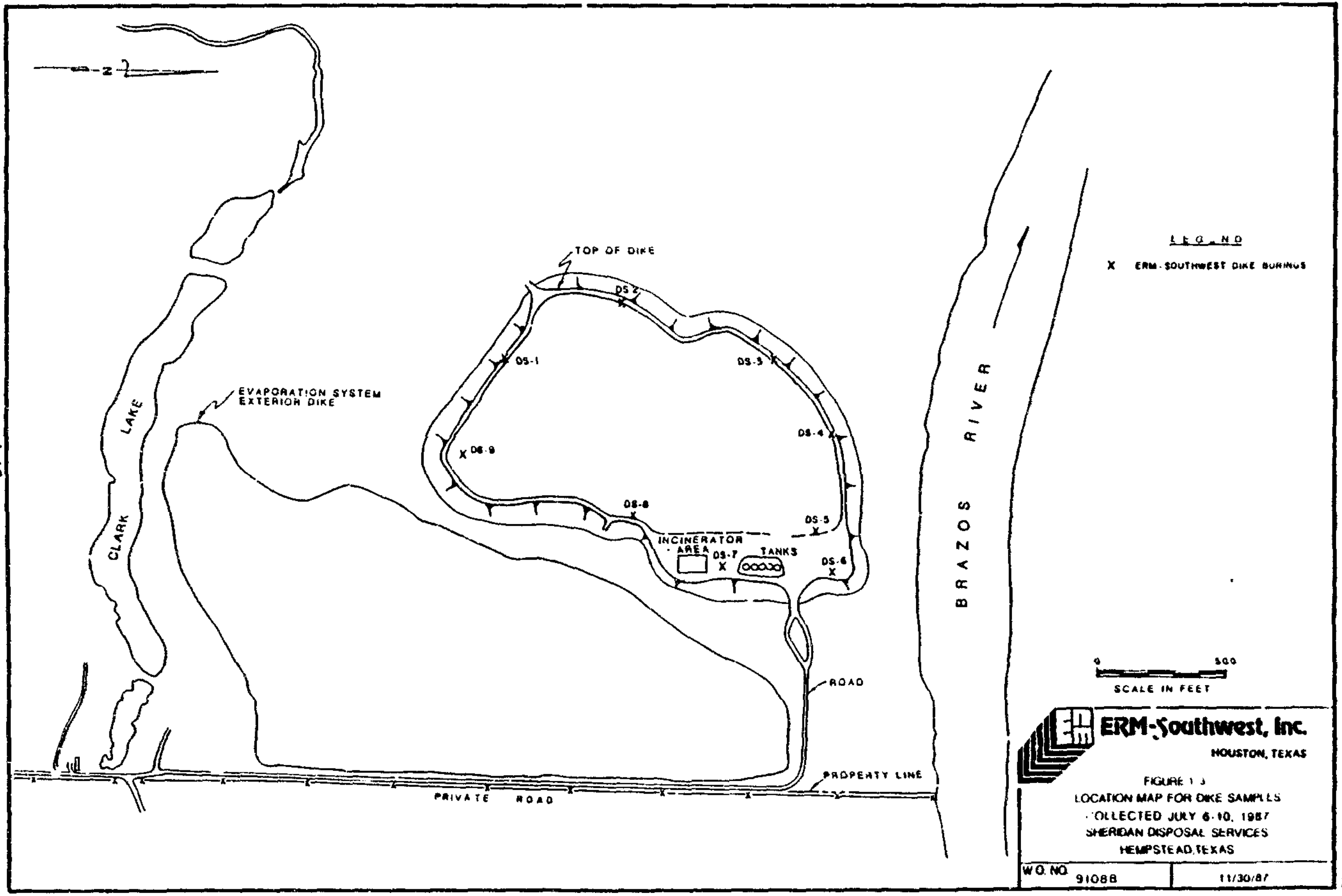

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FIGURE 1-3
LOCATION MAP FOR DIKE SAMPLES
COLLECTED JULY 6-10, 1987
SHERIDAN DISPOSAL SERVICES
HEMPSTEAD, TEXAS

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TABLE 1-3

Development of Alternatives

Phase I - Development of Alternatives

1. Identify potential treatment technologies, containment/ disposal requirements for residuals or untreated waste.

2. Assemble treatment/disposal combinations into alternatives.

3. Develop a range of alternatives attaining various levels of performance.

Phase II- Initial Screening

1. Screen alternatives to narrow the field for more detailed analysis.

Phase III - Detailed Analysis of Alternatives

1. Develop design criteria for each alternative.

2. Analyze alternatives relative to long and short-term effectiveness, implementability and costs.

3. Verify/compare protectiveness, protection of human health and environment; compliance with ARARs; and reduction of toxicity, mobility or volume.

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remedial technologies are evaluated on the basis of their applicability to the site. Next, applicable technologies are combined into complete remedial alternatives. Then, general qualitative information is used to screen out unfeasible or otherwise unacceptable alternatives. Through detailed analysis, more refined and quantitative information is used to develop a ranking of the remaining alternatives. This methodology provides a systematic procedure for identifying and evaluating alternatives, specifying criteria for determining the magnitude and importance of effects resulting from the implementation of an action, and considering measures to mitigate adverse effects.

The FS process results in the development of a range of alternatives that incorporate treatment as a principal element, but vary in the degree to which they minimize the need for long-term management. Based on the final FS, a remedy will be selected which is consistent with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA), and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP).

2 - EVALUATION OF SITE CONDITIONS

Detailed site characterization data are presented in the July 1987 Source Control Remedial Investigation Report and the Baseline Risk Assessment (RA). The site characterization developed in the RI was expanded in the RA to incorporate all newly collected data. This revised characterization served as the basis for the RA. The RA evaluated exposure pathways to determine what level of risk is represented for each completed pathway at the Sheridan site. Completed pathways describe the mechanisms by which site constituents may reach human or environmental receptors. All site conditions evaluated assumed no remedial action.

The initial condition evaluated in the RA was the current site condition. Under current site conditions, site access is limited by the fence; pond water level is controlled through periodic evaporation; dikes are maintained; and the surrounding landuse is agricultural. Under these conditions, there are four completed pathways: 1) inhalation of air emissions from the pond; 2) inhalation of wind blown dust; 3) impact on cattle utilizing Clark Lake; and 4) consumption of organisms from the Brazos River. Under number three, the pathway evaluated site surface water run-off to Clark Lake and its potential impact on the cattle's water source. Under number four, the pathway was represented by the possible leaching of site constituents through the unsaturated zone beneath the site, into the shallow aquifer and subsequent seepage into the Brazos River. Based on an evaluation of the risks represented by the calculated exposure under these completed pathways, the risk assessment concluded that these completed pathways, under existing conditions, represented no significant risk.

In addition to evaluating current site conditions, the RA also examined predicted risk levels assuming the most probable future landuse under a no remediation scenario. In this scenario, the site is no longer restricted, allowing for incidental contact with exposed areas like pond sludges and evaporation system sludges. Pathways evaluated assumed agricultural landuse and secondary hunting activity on the site. Further, the pond water level could exceed capacity. These conditions expand the number of completed pathways. Based on an evaluation of all completed pathways under this most probable future landuse scenario, all projected exposures represented no significant risks except for direct contact with and incidental ingestion of exposed pond, dike and evaporation system sludges.

Summaries of the upper-bound cancer risk and hazard indices for the pathway of direct contact with the exposed pond and evaporation system sludges are contained in Tables 2-1 and 2-2. The cumulative hazard indices did not exceed 100% and therefore the risk represented by direct contact with the noncarcinogenic constituents was judged to be insignificant. However, the cumulative carcinogenic risk did exceed 1 x 10^{-5} for exposure to sludges. As the summary tables indicate, a substantial majority of the identified risk is contributed by a single constituent, namely PCBs.

At the Sheridan site there are three areas that contain wastes: the main pond; the evaporation system; and the main pond dike. The sludges in the main pond and evaporation system present the greatest potential risks because their accessibility presents a greater likelihood of direct contact by humans or wildlife. Unlike the main pond and evaporation system sludges, the affected soils in the dike are covered with unaffected soil and vegetative cover. Dike borings indicated that affected soils are covered by an overburden of three or more feet of vegetated, secure soils. Thus, the dikes present a much less significant risk than the other two compartments. Of course, to the extent that there are exposed sludges or affected soils on the dikes, the potential risk would be greater, probably presenting risks comparable to evaporation system sludges. 0109699

A second risk identified in the RA, but not quantified, was the potential long-term risk or threat of erosion of the Brazos River bank nearest the main pond. While the assimilative capacity of the river is substantial, acute impacts on the river could be significant if erosion were to reach the impoundment. Consequently, the results of the RA indicate that in order to protect human health and the environment under the current and most probable future landuse conditions, direct contact with the pond and evaporation system sludges should be controlled or eliminated, and the impact of long-term erosion minimized.

TABLE 2-1

Summary of Total Hazard Index and Total Carcinogenic Risk
Posed by Direct Contact with Main Pond Sludge, 52 Days/Year

INDICATOR CHEMICAL	Total CDI (mg/kg-day)	EPA AIC (mg/kg-day)	Hazard Index HI=CDI/AIC	EPA CPF (mg/kg-day)^-1	Upper Bound Cancer Risk 58yr/70yr * CDI*CPF
Benzene	8 25E-05	NA	NA	0 052	3 55E-06
2 4-Dimethylphenol	1 07E-05	0 0014 (1)	0 76%	NA	NA
Ethylbenzene	2 57E-04	0 1	0.26%	NA	NA
Naphthalene	6 77E-06	0 41 (2)	0 0017%	NA	NA
PCBs (Total) (3)	1 89E-05	NA	NA	4 34	6 80E-05
Phenol	2 18E-05	0 04	0 05%	NA	NA
Tetrachloroethylene	9 51E-06	0 02	0 05%	0.051	4 02E-07
Toluene	9 62E-05	0 3	0.03%	NA	NA
Trichloroethylene	3 93E-06	NA	NA	0.011	3 59E-08
Chromium	5.61E-07	1	0 0001%	NA	NA
Lead	9 61E-07	0 0014	0.07%	NA	NA
Nickel	1 59E-07	0 01	0 0016%	NA	NA
Zinc	1 36E-06	0 21	0 0006%	NA	NA
CUMULATIVE RISKS FOR ALL INDICATORS					
Total Hazard Index			1 23%		
Total Carcinogenic Risk					7 20E-05

CDI = Chronic Daily Intake as calculated from direct exposure for each indicator chemical (from Tables 11-5A through 11-5M).

AIC = Acceptable Chronic Intake (see Appendix C)

CPF = Cancer Potency Factor (see Appendix C)

(1) Number is draft value from EPA Region VI for 3,4-Dimethylphenol No draft value for 2,4-DMP

(2) Personal communication, hand-written notes from Fred Reitman, EPA Region VI, 2/22/88.

(3) PCB calculations using dermal and gastrointestinal absorption factors from OHEA Document EPA/600/6-86/002 Development of Advisory Levels for Polychlorinated Biphenyls (PCBs) Cleanup, May 1986

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TABLE 2-2

Summary of Total Hazard Index and Total Carcinogenic Risk
Posed by Direct Contact with Evaporative Sludge, 52 Days/Year

INDICATOR CHEMICAL	Total CDI (mg/kg-day)	EPA AIC (mg/kg-day)	Hazard Index HI=CDI/AIC	EPA CPF (mg/kg-day)^-1	Upper Bound Cancer Risk 58yr/70yr * CDI*CPF
Benzene	3.37E-06	NA	NA	0.052	1.45E-07
2,4-Dimethylphenol	7.76E-07	0.0014 (1)	0.06%	NA	NA
Ethylbenzene	2.36E-05	0.1	0.02%	NA	NA
Naphthalene	0.00E+00	0.41 (2)	0.00%	NA	NA
PCBs (Total) (3)	2.98E-06	NA	NA	4.34	1.07E-05
Phenol	2.38E-05	0.04	0.06%	NA	NA
Tetrachloroethylene	1.71E-06	0.02	0.01%	0.051	7.23E-08
Toluene	1.30E-05	0.3	0.0043%	NA	NA
Trichloroethylene	0.00E+00	NA	NA	0.011	0.00E+00
Chromium	1.73E-07	1	0000%	NA	NA
Lead	3.90E-07	0.0014	0.03%	NA	NA
Nickel	7.49E-08	0.01	0.0007%	NA	NA
Zinc	1.79E-06	0.21	0.0009%	NA	NA

CUMULATIVE RISKS FOR ALL INDICATORS

Total Hazard Index	0.18%	
Total Carcinogenic Risk		1.09E-05

CDI = Chronic Daily Intake as calculated from direct exposure for each indicator chemical (from Tables II-5A through II-5M)

AIC = Acceptable Chronic Intake (see Appendix C)

CPF = Cancer Potency Factor (see Appendix C)

(1) Number is draft value from EPA Region VI for 3,4-Dimethylphenol. No draft value for 2,4-DMP

(2) Personal communication, hand-written notes from Fred Reitman, EPA Region VI, 2/22/88.

(3) PCB calculations using dermal and gastrointestinal absorption factors from OHEA Document EPA/600/6-86/002 Development of Advisory Levels for Polychlorinated Biphenyls (PCBs) Cleanup, May 1986

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3 - SOURCE CONTROL OBJECTIVES

The NCP states the general goals and objectives of remedial actions where it defines the appropriate extent of remedies in 40 CFR 300.68(i) as: "a cost-effective remedial alternative that effectively mitigates and minimizes threats to and provides adequate protection of public health and welfare and the environment." Compliance with this overall remedial objective is measured, at least in part, by evaluating the selected alternatives' ability to mitigate site-specific risks, meet the statutory preferences for the selection of a remedy, and achieve compliance with ARARs. Criteria based on these more specific objectives are outlined below.

3.1 Risk-Based Objectives

The exposure pathways evaluated in the Risk Assessment establish the primary basis for identifying site-specific goals for each remedial alternative where existing environmental regulatory criteria are not available. As indicated in Section 2, of all the potential pathways operating through the four environmental media of air, surface water, ground water and soil, only direct contact with exposed pond and evaporation system sludges represented an unacceptable risk. Consequently, the principal remedial objective for the Sheridan site is prevention of direct contact with pond and evaporation system sludges.

In addition, all remedial alternatives considered are designed to satisfy the following objectives:

1. Minimize potential impacts on shallow ground water.
2. Minimize potential impacts on surface waters.
3. Minimize potential for river bank erosion.
4. Minimize the potential for completion of new exposure pathways.

3.2 Section 121(b) Statutory Objectives

Section 121(b) of CERCLA, as amended by SARA, states as follows: "Remedial actions in which treatment which permanently and significantly reduces the volume, toxicity or mobility of the hazardous substances, pollutants, and contaminants is a principal element, are to be preferred over remedial actions not involving such treatment." Section 121(b) also expands the goals of remedial actions to include a preference for remedial actions that utilize permanent solutions and alternative treatment technologies or resource technologies to the maximum extent practicable.

3.3 Section 121(d) Statutory Objective (ARARs)

Section 121(d) of CERCLA, as amended by SARA, describes the types of standards that a remedial action is required to meet. The fundamental standard for evaluating remedies under Section 121 remains "protection of human health and the environment". In addition, the standards, requirements, criteria, or limitations under any Federal environmental law, or any more stringent State standard, that are "legally applicable" or "relevant and appropriate" must be met. To obtain compliance with this general standard, and in recognition of the EPA's July 9, 1987 memorandum "Interim Guidance on Compliance with Applicable or Relevant and Appropriate Requirements", remedial alternatives were analyzed to determine what regulatory requirements would be applicable or relevant and appropriate. Table 3-1 presents the universe of environmental standards that were reviewed to determine which of them had a bearing on remedial action at the site.

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ARARs must be determined on a site-specific basis. The main feature of the Sheridan site is the 15-acre pond or surface impoundment used for past disposal activities. In conducting the ARARs evaluation, it became clear that while there are various regulatory provisions that are either applicable or relevant and appropriate depending on the type of technology utilized, the one key ARAR that would be relevant and appropriate upon completion of the selected remedy was the surface impoundment closure requirements under RCRA. Those closure requirements are the foundation of the remedial alternates developed and evaluated in this FS.

Where closure will take place with some hazardous constituents remaining on-site, the surface impoundment must be closed as a landfill. Under these closure requirements, free liquids would have to be removed from the main pond. In addition, the remaining material would have to be stabilized or solidified to a bearing capacity sufficient to support a final cover. Finally, a cover would have to be placed over the impoundment designed and constructed to:

(A) Provide long-term minimization of the migration of liquids through the closed impoundment;

(B) Function with minimum maintenance;

Table 3-1

STANDARDS, REQUIREMENTS, CRITERIA, OR LIMITATIONS EVALUATED FOR ARARs DETERMINATION

- Safe Drinking Water Act
- Clean Water Act
- Solid Waste Disposal Act (RCRA)
- Toxic Substances Control Act (TSCA)
- Occupational Safety and Health Act
- Hazardous Materials Transportation Act
- National Historic Preservation Act
- Archaeological and Historical Preservation Act
- Historic Sites, Buildings and Antiquities Act
- Fish and Wildlife Coordination Act
- Endangered Species Act
- Rivers and Harbors Act of 1899
- Wilderness Act
- Scenic River Act
- Coastal Zone Management Act
- Texas Clean Air Act
- Texas Solid Waste Disposal Act
- Texas Water Code
- Texas Water Quality Standards
- Marine Protection, Research and Sanctions Act
- Executive Order Requirements for Flood Plains and Wetlands
- Federal Insecticide, Fungicide, and Rodenticide Act

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(C) Promote drainage and minimize erosion or abrasion of the final cover;

(D) Accommodate settling and subsidence so that the cover's integrity is maintained; and

(E) Have a permeability less than or equal to the permeability of any bottom liner or natural subsoils present.

Further, following closure, the integrity and effectiveness of the final cover must be maintained, including making repairs as necessary.

An evaluation of the potential ARARs for affected materials and soils, for discharge to surface water, for ground water, and for air emissions results in the identification of the following relevant and appropriate criteria or standards:

1. RCRA requirements contained in 40 CFR, Part 264, listed in Table 3-2.

2. RCRA requirements contained in 40 CFR Parts 262 and 263 to the extent that a remedial alternative involves off-site transportation of materials. Additionally, 49 CFR Parts 107 174-177 relating to Hazardous Materials Transportation would be relevant and appropriate.

3. RCRA requirements contained in 40 CFR Part 264, Subpart B, related to general facility standards, consisting of:

   a. 40 CFR Section 264.14 (site security).
   b. 40 CFR Section 264.17 (incompatible waste).

4. RCRA requirements contained in 40 CFR Part 264, Subpart G, consisting of:

   a. 40 CFR Section 264.114 (equipment decontamination).
   b. 40 CFR Section 264.117 (monitoring).

5. RCRA requirements contained in 40 CFR Part 264, Subpart M relating to land treatment.

   a. 40 CFR Section 264.273.
   b. 40 CFR Section 264.278.

6. RCRA requirements contained in 40 CFR Part 264, Subpart N relating to landfills.

Table 3-2

APPLICABLE OR RELEVANT AND APPROPRIATE RCRA REQUIREMENTS

A. Cover (40 CFR Part 264, Sub-part N)

1. Eliminate Free Liquids.

2. Stabilize to a bearing capacity sufficient to support final cover.

3. Cover designed to:

   a. provide long term minimization of migration of liquids through closed area;
   b. function with minimum maintenance;
   c. promote drainage and minimize erosion;
   d. accommodate settling and subsidence so that cover integrity is maintained; and
   e. have a permeability less than or equal to permeability of any bottom liner system or natural subsoil.

4. Post-Closure Designed to:

   a. maintain integrity and effectiveness of cover;
   b. maintain ground water monitoring system;
   c. prevent run-on and run-off from eroding or otherwise damaging final cover; and
   d. prevent disturbance of cover.

B. Incinerator (40 CFR Part 264, Support O and 40 CFR Section 761.70)

1. Incinerator equipped with high-temperature secondary combustion chamber and wet scrubber designed to meet particulate, HCL and destruction removal efficiency limitations.

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7. TSCA requirements contained in 40 CFR Part 761, Subpart D, consisting of:

   a. 40 CFR section 761.70 (incineration)

8. TSCA requirements contained in 40 CFR part 761, Subpart G.

9. Section 4.01 of the Texas Clean Air Act.

10. Sections 329.41-.49, 333.17-.19 of Chapter 31 of Texas Administrative Code Relating to State Water Quality Standards as applied to the Brazos River.

11. Federal Water Quality Criteria for Fresh Water Aquatic Life Protection, and Consumption of Organisms.

12. Clean Water Act requirements for application of best engineering judgment prior to discharge, 40 CFR Part 125.

    a. Process water and potentially contaminated storm water collected and routed, as necessary, to activated sludge waste water treatment system equipped with carbon polishing.

13. All developed remedial alternatives have taken into account Executive Order 11988 on Flood Plain Management and will be implemented in such a mann' as to minimize any impact on the flood plain.

In addition to these ARARs, during site remediation the Worker Health and Safety Plan would require compliance with the relevant provisions of the Occupational Health and Safety Act.

Additional details on how these ARARs were identified are outlined below.

3.3.1 ARARs for Affected Material and Soils

RCRA Requirements

Even though they are not legally applicable, certain RCRA requirements, including the RCRA design and operating standards, may be considered relevant and appropriate based on the fact that they address problems or situations sufficiently similar to those encountered at the Sheridan site. Table 3-2 lists those RCRA requirements deemed relevant and appropriate to the various remedial alternatives analyzed in this FS.

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Land Ban Requirements

Waste banned pursuant to the Hazardous and Solid Waste Amendments of 1984 (HSWA) cannot be placed in or on the land unless first treated to levels achieved by best demonstrated available technology (BDAT) for each hazardous constituent in the waste. "Placement" triggers the land disposal requirements, occurring only when disposal occurs. Therefore, for placement to occur, hazardous waste must be picked-up and moved across the boundary of a RCRA "unit area of contamination". Applying this definition to the Sheridan site, it is clear that "placement" does not occur when waste is consolidated within an area of contamination, capped in place (including grading prior to capping) or treated on-site.

Therefore, since the Sheridan site is considered an "area of contamination" for the reasons discussed above, "placement" does not occur during any of the proposed remedial actions. Therefore, the land disposal requirements are neither "applicable" nor are they considered "relevant and appropriate".

PCB Contaminated Waste

The presence of PCBs has been detected in samples collected at the site. Generally, the manufacture, treatment and disposal of PCBs is regulated under the Toxic Substances Control Act (TSCA), 15 U.S.C. Section 2601 et seq. In April 1987, the EPA published a general PCB Spill Cleanup Policy, 40 CFR Sections 761.120-761.135 (1987). This policy is intended to deal with unintentional spills, leaks or other uncontrolled discharges of materials containing PCBs in concentrations of 50 ppm or greater. This policy establishes requirements for the cleanup of these spills where PCBs have been released into the environment. Different cleanup levels are established depending upon the spill location, the potential for exposure to residual PCBs remaining after the cleanup, the concentration of PCBs initially spilled, and the nature and size of population at risk of exposure.

By its terms, the EPA PCB spill policy only applies to spills which occur after the effective date of the policy, which was May 4, 1987 [40 CFR Section 761.120 (a)(1)]. Clearly, these requirements are not applicable to residual PCBs remaining at the Sheridan site. However, the nature and scope of these regulations is such that they are considered relevant and appropriate. Specifically, the level of 25 ppm specified in 40 CFR Section 761.125 (c)(3) is the most appropriate action level for the Sheridan site.

The TSCA cleanup policy is an ARAR that defines action levels for cleanup. Action levels, in this sense, are levels of concentration of PCBs in material at or above which the material must be remediated.

3.3.2 ARARs for Discharge to Surface Water

The Brazos River runs adjacent to the site and may be subject to point source discharges from the site during remediation. The point sources may consist of water generated by remedial activities as well as stormwater flows. This discharge may be treated as necessary by physical and chemical treatment, principally carbon adsorption, prior to discharge. At the completion of remediation, there will be no point source discharge.

However, at the completion of remediation, the Brazos may be impacted by a non-point source discharge, namely ground water seepage from the upper unconfined sand zone. The only standards that could be "legally applicable or relevant and appropriate" to this discharge would be State water quality standards or Federal water quality criteria.

State water quality standards are legally enforceable counterparts to the Federal water quality criteria. In Texas, the State water quality standards are set forth in Chapters 319 and 333 of the rules and regulations of the Texas Water Commission. Those standards establish certain numerical criteria which are legally applicable to waters in the Brazos. All remedial alternatives are designed to satisfy the requirements of 31 TAC Sections 319.21-29, 307.1 to 307.10 for the discharge of water from the upper unconfined sand zone to the Brazos.

With respect to concentrations of chemicals in the river:

(1) Final Maximum Concentration Limits (MCLs) are considered relevant and appropriate where MCLs are available; and

(2) State and Federal water quality criteria for the protection of human health are relevant and appropriate where MCLs are not available.

3.3.3 ARARs for Ground Water

The EPA's ground water protection strategy is based on the "differential protection" of ground water (i.e., ground water protection as it relates to a specific classification of an aquifer). Under the strategy, ground waters are classified as follows:

- Class I - ground waters that are highly vulnerable and either an irreplaceable source of drinking water or ecologically vital;
- Class II - ground waters currently used or potentially available for drinking water or other beneficial use; and
- Class III - ground waters not a potential source of drinking water and of limited beneficial use.

For Class I and Class II ground water Maximum Concentration Limits (MCLs) established under the Safe Drinking Water Act would be applicable for ground water sources which qualify as a public water system or a community water system. MCLs may also be relevant and appropriate to ground water that would not currently qualify as such systems but could potentially so qualify in the future. Similarly, where the State has established drinking water standards that are more stringent than the Federal MCLs, these may be applicable or relevant and appropriate.

There are two water-bearing zones underlying the site. The uppermost zone is unconfined. The next zone, which is separated from the upper zone by a clay aquitard, is referred to as the confined aquifer. Where the potential ground water pathway of concern is through a surface water discharge, risk-based numbers often form the basis for establishing protective levels for the saturated zone. This approach is also utilized where MCLs are not appropriate. Specific factors that may influence the appropriate risk level include:

(1) Feasibility of providing an alternative water supply;

(2) Current use of the ground water;

(3) Effectiveness and reliability of institutional controls;

(4) Ability to monitor and control the movement of contaminants in the ground water.

Also factored into decision making should be:

(1) Ability to limit extent of contamination;

(2) Impact of contamination on environmental receptors;

(3) Technical practicability and cost of remedial alternatives.

Clearly, MCLs are not legally applicable to the shallow unconfined ground water source at the Sheridan site. This is not a drinking water source being supplied to at least 25 individuals at least 60 days out of the year. Indeed, this source is not supplied to any individuals, any days of the year, and institutional controls will be implemented to prevent its use in the future.

The inapplicability of MCLs does not mean that this ground water source does not need to be protected to levels that will avoid an endangerment to human health and the environment. Since the only receptor for this ground water source is the Brazos River, it is expected that this standard can be achieved by ensuring that any potential impact from the site on the ground water will not result in levels of constituents that, once discharged to the river, would have an adverse impact on human or aquatic receptors. However, this must be confirmed through the demonstration that an alternate concentration limit is appropriate for this site. This demonstration is currently being prepared and it is believed that such a demonstration can be made.

Taking into account the mixing zone of initial dilution that would result from the seepage of the shallow sand into the Brazos River it is possible to back calculate permissible ground water concentrations from applicable water quality standards.

Source control remediation would then need to assure that these levels were never exceeded in the shallow unconfined ground water zone.

3.3.4 ARARs for Air Emissions

Based on a review of all potentially applicable air emission-related regulations and standards, the only "legally applicable or relevant and appropriate requirement" for air emissions at the completion of remediation is specified in Section 4.01 of the Texas Clean Air Act, which provides that "no person may cause, suffer, allow or permit the emission of air contaminants or the performance of any activity which causes or contributes to, or which will cause or contribute to, a condition of air pollution". "Air pollution" is defined "as the presence in the atmosphere of one or more air contaminants or a combination thereof, in such concentration and of such duration as may tend to be injurious to or to adversely affect human health or the environment, animal life, vegetation, or property, or as to interfere with the normal use and enjoyment of animal life, vegetation, or property."

To assure compliance with this standard, each of the proposed remedial alternatives contains provisions for periodic ambient monitoring to verify that site conditions existing at the completion of remediation are not causing or contributing to a condition of air pollution. All of remedial actions are designed to insure the emissions are in compliance with this ARAR.

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4 - SCREENING OF SOURCE CONTROL TECHNOLOGIES

4.1 Purpose and Scope

Differences between general response actions and technologies are characterized based on their application. In accordance with the RA, pond and evaporation system sludges represent the primary waste compartment to be addressed at the site. "Sludge" is defined as the sum of the following materials containing PCBs above the 25 ppm PCB action level identified in Section 3:

1.	Pond Sludge	Sludge contained within the main pond.
2.	Evaporation System Sludge	Sludge contained within the evaporation system.
3.	Oily Surface Soil	Oily material on the surface of the main pond dikes, e.g. existing surface to a depth of six inches.
4.	Floating Oil and Emulsion	Floating oil and emulsion on the pond water.
5.	Affected Soil Under Pond	Soil under the pond intermixed with the pond sludge.

Given the fact that the pond sludges are located beneath the pond water, general remedial technologies for dealing with the pond water were also evaluated.

4.2 Source Control General Response Actions

General response actions are broad classes of remedies intended to address remedial objectives at a site. Table 4-1 presents the general response actions considered for the Sheridan site. General response actions are identified as applicable if they have the potential to contribute to site remediation either alone or in combination with other response actions. Each response action is identified as being applicable or not applicable to the pond water and sludge and the rationale for that judgment is presented, as appropriate.

4.3 Suitable Remedial Technologies

In the next step, remedial technologies, corresponding process options, and applicable general response actions were identified. These remedial technologies were screened in a process

TABLE 4-1

General Response Actions

General Response Action	Applicable To Pond Water	Applicable To Sludge	Reasons Applicable Or Not Applicable
No Action	Yes	Yes	The site is not currently posing a threat to human health.
Containment	No	Yes	Unless it is first solidified, containment would not be applicable to the pond water. The sludge could be capped following dewatering of the pond to control leachate formation and direct contact.
Pumping, On-Site	Yes	Yes	Pumping could be used for transferring water from the pond to on-site treatment or discharge, and for transferring sludge to on-site treatment.
Collection	Yes	Yes	Pond water and sludge are both amenable to collection.
Diversion	No	No	There are existing dikes and berms to collect potentially contaminated run-off and divert clean run-on.
Removal	Yes	Yes	Pond water could be removed, treated on-site and discharged. Removal of all sludge could also be accomplished.
On-Site Treatment	Yes	Yes	The water and sludge should both be amenable to treatment techniques which could be conducted on-site.
In-situ Treatment	Yes	Yes	Several treatment methods could be conducted in-situ for both pond water and sludge.
On-Site Disposal	Yes	Yes	The water could be disposed of on-site in the evaporation system. The sludge could be disposed of in-situ or at another location on the site.

TABLE 4-1 (Cont'd)

General Response Actions

General Response Action	Applicable To Pond Water	Applicable To Sludge	Reasons Applicable Or Not Applicable
Off-Site Disposal	Yes	Yes	All or part of the pond water and sludge could be disposed of off-site.
Alternate Drinking Water	No	No	There is no indication that the site has impacted any source of drinking water.
Off-Site Treatment	Yes	Yes	It may be feasible to send the pond water to a publicly or privately owned wastewater treatment works for treatment and subsequent discharge. Similarly, sludge couldbe hauled and treated off-site.

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involving five considerations: the state of technology development, performance record, inherent construction and operation problems, site conditions, and waste characteristics. Innovative technologies that were potentially cost effective, were preserved. Technologies and process options were assessed independently without regard to potential advantages and disadvantages of technologies when applied in combination. Technologies were assessed based on their direct suitability to existing conditions at the site. Potential ancillary use of a technology to treat a stream produced by another technology was not expressly evaluated, although a few traditional examples of such uses are identified.

The results of this screening of technologies for the Sheridan Disposal Services site are summarized in Table 4-2. Remedial technologies are grouped by the environmental media which they address. Each technology is identified as being suitable or not suitable, and the rationale for that judgment is briefly identified.

The remedial technologies remaining after screening are summarized in Table 4-3. The suitability of each technology is identified according to waste compartment. Those process options and technologies that were screened out will not be carried forward for remedial alternative assembly.

TABLE 4 2

Screening of Remedial Technologies

Treatment	Suitable	Rationale
A Air Controls		
The following technologies were considered for controlling air emissions from the SDS site The site is not currently presenting an air emissions problem but air controls may be needed during remediation		
o Capping	yes	Minimizes potential for air emissions
o Dust Control Measures - Polymers - Water	no	Dust emissions are not a problem, however, some technologies may require dust suppression during implementation
B Surface Water Controls		
The following technologies were considered for their suitability for preventing affected run-off from being generated or for controlling its release from the site.		
o Capping - Synthetic membranes - Clay - Asphalt - Multimedia cap - Concrete - Chemical sealants/stabilizers	yes	Generation of affected run-off could be prevented by capping
o Grading	yes	Generation of affected run-off would be minimized by preventing run-on to affected areas
- Scarification	no	Surface eros on not a concern
- Tracking	no	Shallow slopes do not warrant tracking.
- Contour furrowing	yes	Prevent run-on/collect run-off
o Revegetation	yes	Final cover erosion control
- Grasses	yes	Surrounded by pasture
- Legumes	yes	Surrounded by pasture

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TABLE 4-2 (Cont'd)

Screening of Remedial Technologies

Treatment	Suitable	Rationale
B Surface Water Controls (Continued)		
o Diversion and Collection Systems	yes	Prevent run-on/collect run-off
- Dikes and berms	yes	Prevent run-on/collect run-off
- Ditches and trenches	yes	Prevent run-on/collect run-off
- Terraces and benches	no	Surface erosion not a problem
- Chutes and downpipes	yes	Treated water discharge
- Storage basins	yes	Run-off storage prior to treatment
- Seepage basins	no	Drainage not a problem
- Sedimentation basins and ponds	no	Surface erosion not a problem
- Levees	yes	Prevent pond overtopping/flood protection
- Addition of freeboard	yes	Prevent pond overtopping
- Floodwalls	yes	100 year flood protection

C. Leachate Controls

The following technologies were considered for their suitability for preventing or controlling leachate generation and/or migration to ground water.

Treatment	Suitable	Rationale
o Capping (see B.) Use of a cap would prevent leachate from forming by preventing infiltration of rainfall	yes	Prevents infiltration
o Containment barriers	yes	Containment barriers such as slurry walls and grout curtains could be used for lateral, subsurface containment
o Soil mixing	yes	Treatment by adsorption, physical entrapment and chemical reaction
o Subsurface Collection Drains - French drains - Tile drains - Pipe drains (dual media drains)	no	Not relevant for source control operable unit.
o Landfill or vault	yes	Leachate control integral with conventional

TABLE 4-2 (Cont'd)

Screening of Remedial Technologies

Treatment	Suitable	Rationale
D. Gas Migration Controls		
o Gas collection and/or recovery	yes	in conjunction with cap
- Passive pipe vents	yes	
- Passive trench vents	yes	
- Active gas collection systems	yes	
E. Excavation and Removal of Pond Water and Sludge		
Excavation and removal of pond water and sludge to on-site or off-site treatment or disposal is feasible		
o Excavation and removal		
- Backhoe	yes	Sludge excavation
- Cranes and attachments	yes	Sludge excavation
- Front end loaders	yes	Sludge excavation
- Scrapers	yes	Sludge excavation
- Pumps	yes	Water and sludge excavation
- Industrial vacuums	yes	Water and sludge excavation
- Drum grapplers	yes	Drum handling
- Forklifts and attachments	yes	Drum handling
o Other removal		
Mechanical dredging		
- Clamshell	yes	Sludge removal
- Dragline	yes	Sludge removal
- Backhoe	yes	Sludge removal
Hydraulic dredging		
- Plain suction	yes	Sludge removal/suspension
- Cutterhead	yes	Sludge removal/suspension
- Dustpan	yes	Sludge removal/suspension
Pneumatic dredging		
- Airlift	no	Introduction of air emissions
- Pneuma	no	High solids not required, inefficient
- Oozer	no	Inefficient, limited availability

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TABLE 4-2 (Cont'd)

Screening of Remedial Technologies

Treatment	Suitable	Rationale
F Treatment (Continued)		
o Biological treatment		
- Activated sludge	yes	water and sludge
- Trickling filters	no	High sludge viscosity
- Aerated lagoons	yes	water and sludge
- Waste stabilization ponds	yes	water and sludge
- Rotating biological disks	no	concern for toxic shocks
- Fluidized bed bioreactors	yes	water and sludge
- Composting	yes	Sludge
o Physical treatment		
- Flow equalization	no	Not a dynamic system
- Flocculation	yes	Only with other treatments
- Sedimentation	yes	Only with other treatments
- Activated carbon	yes	water or gas phase
- Kleensorb	no	No relevent data identified
- Ion exchange	yes	Heavy metals removal
- Reverse osmosis	no	concentrations too low
- Liquid-liquid extraction	yes	Oil/water separation
- Oil-water separator	yes	Oil/water separation
- Filtration	yes	water/solids separation
- Dissolved air flotation	yes	water/solids separation
- Solvent extraction	yes	Oil/water/solids separation

G. Land Disposal/Storage

Construction of an on-site permanent disposal or storage facility is feasible. Land application and surface impoundments could be used to provide treatment as well as storage or disposal.

Treatment	Suitable	Rationale
o Landfills	yes	Sludge, pretreatment required
o Surface impoundments	yes	Temporary treatment basins
o Land application	yes	Biotreatment of sludge
o Waste piles	no	Not effective
o Deep well injection	yes	Liquid wastes, subject to geological constraints
o Temporary storage	yes	water/sludge

TABLE 4-2 (Cont'd)

Screening of Remedial Technologies

Treatment	Suitable	Rationale
F. Treatment		
Many technologies for treatment are available. The following technologies were considered for their suitability at the site		
o Hydrolysis	no	Not applicable to site conditions
o Oxidation	no	Not applicable to site conditions
o Reduction	no	Not applicable to site conditions
o Aeration	yes	Biotreatment of sludge and pond water
o Solvent flushing	no	Liquid-liquid extraction more controlled alternative
o Neutralization	no	Not applicable
o Polymerization	no	No relevant data identified
o Sulfide precipitation	no	Organics interference
o Chemical dechlorination	yes	Possible in conjunction with solvent extraction
o Solidification/Stabilization/Fixation	yes	Proven, treatment by physical entrapment and chemical reaction
o Incineration	yes	Available, proven for organics' destruction, but concentrates metals
- Rotary kiln	yes	Good solids handling - immobile
- Fluidized bed	yes	Good solids handling - mobile
- Multiple hearth	no	Fair solids handling-immobile
- Liquid injection	no	Liquid phase, may use with solvent extraction
- Molten salt	no	Not commercially available
- High temperature fluid wall	no	Fair to poor solids handling
- Plasma arc pyrolysis	no	Not commercially available
- Cement kiln	no	Not appropriate for PCBs
- Pyrolysis/starved combustion	no	No relevent data identified
- Wet air oxidation	no	Fair to poor solids handling
- Industrial boiler or furnace	no	Not appropriate for PCBs
o Gaseous waste treatment		
- Activated carbon	yes	Ancillary to other technologies
- Flares	yes	Ancillary to other technologies
- Afterburners	yes	Ancillary to other technologies

5 - ASSEMBLY OF SOURCE CONTROL ALTERNATIVES

The objective of this task is to combine surviving technologies from Section 4 into a range of source control remedial alternatives for the SDS site which focus on the remediation objectives presented in Section 3, and which are consistent with EPA requirements and sound engineering practice. A total of ten remedial action alternatives were developed, including no-action and limited action plans that are comprised of components not specifically discussed in Section 4. A fact sheet for each alternative provides a discussion of the disposition of site material along with the sequence of the proposed remedial work. This information is used along with considerations of effectiveness, implementability and cost to select a more limited set of alternatives for detailed analysis.

5.1 Assembly of Alternatives

From the list of remedial action technologies contained in Table 4-3 it is possible to assemble complete remedial alternatives which address the remedial objectives in Section 3, attain Federal and State requirements that are applicable or relevant and appropriate and are protective of human health and the environment.

The EPA guidance documents issued since the passage of the Superfund Amendments and Reauthorization Act set forth a general scheme for developing a range of remedial alternatives that should be evaluated in the FS. The general categories within this range are as follows:

1. A No Action alternative.

2. Alternatives that involve containment of waste with little or no treatment, but provide protection of human health and the environment.

3. Alternatives that reduce the principal threat posed at the site through treatment, but that do not necessarily involve treatment of all waste.

4. Alternatives that utilize alternative treatment or resource recovery technologies.

5. Alternatives that minimize the need for long-term management (including monitoring) at the site.

As indicated in previous sections, the principal feature at the Sheridan Disposal Services site is the 15 acre surface impoundment or main pond. The main projected risk to human health and the environment that exists as a result of the waste in this impoundment is through direct contact with exposed sludges. Another risk identified in this RA is the long-term erosion of the bank of the Brazos River. The risk associated with direct contact can be substantially mitigated by providing security fencing around the areas with exposed sludges. The risk associated with erosion of the river bank can be controlled through installation of a spur jetty system. These procedures for risk mitigation are evaluated in the Limited Action Alternative.

All alternatives except the No Action and the Limited Action Alternatives involve closure of the main pond. Before the pond can be closed, the pond sludge must undergo some form of treatment. Therefore, each suitable technology for sludge treatment (see Table 5-1) forms the primary basis for the assembly of a remedial action alternative. Other suitable technologies, such as those applying to pond water treatment prior to discharge, were considered secondary elements of the overall remedial action and were used to supplement the sludge treatment technologies. The use of certain types of land disposal and storage technologies, while technically suitable for managing the pond sludge, did not offer a stand-alone basis for assembly of an alternative.

As indicated in Section 3.3, surface impoundment closure requirements involve installation of an engineered cap. Installation and maintenance of a cap will remove the threat posed by direct contact, eliminating the need for fencing. All remaining alternatives involve closure of the main pond through installation and maintenance of a cap.

In order to install the cap, the pond water that is currently contained within the impoundment would need to be removed prior to capping. As indicated in Table 4-3, there are several treatment options available for dealing with the pond water and any process wastewater. However, industrial wastewater treatment experience indicates that conventional equalization, flocculation/precipitation and settling, filtration and carbon adsorption will be sufficient for any water requiring treatment. Each alternative discussed below proposes to test such waters and subject them to treatment as necessary prior to discharge.

Once the pond water is removed, the requirement to eliminate free liquids would require the utilization of some additive mixture to bulk the pond sludge sufficiently to remove free liquids

TABLE 5-1

Development of Source Control Alternatives

Technology	Rationale for Use	Element of Alternative
A. <u>Air and Water Controls</u> o Capping o NPDES Discharge to Brazos River o Surface Water Controls - Grading (contour furrowing) - Revegetation (grasses, legumes) - Diversions and collection systems o Leachate Controls o Gas Migration Controls	Do not form the basis for an alternative. Will not address remedial objectives without use of additional technologies. All potential alternatives would probably use one or more of these technologies.	Secondary
B. <u>Excavation and/or Removal</u> o Excavation and Removal	Does not form the basis for an alternative.	Secondary
C. <u>Treatment</u> o Soil aeration	Biological degration and immobiliation similar to refinery oily waste land treatment.	Primary
o Solidify, stabilize or fix - Cement-based - Lime-based - Fly ash based - Proprietary	Immobilization. Stabilized material provides firm base for cap construction.	Primary
o Incineration		
- Rotary kiln	Destruction of organic constituents.	Primary
- Fluidized bed	Cannot handle debris or soil.	Not Used
o Biological Treatment		
- Activated Sludge	Short-term biological degradation of most organic constituents.	Primary
- Aerated Lagoons	Long-term biological degration of most organic constituents.	Primary
- Waste Stabilization Ponds	Sludge handling cannot be controlled.	Not Used
- Fluidized Bed Reactors	Sludge handling difficult	Not Used

TABLE 5-1 (Cont'd)

Development of Source Control Alternatives

Technology	Rationale for Use	Element of Alternative
o Chemical treatment		
- Precipitation	Not applicable to sludge.	Secondary
- Chemical dechlorination	Pretreatment required.	Not Used
o Physical treatment	Not applicable to sludge.	Secondary
- Flocculation	Not applicable to sludge.	Secondary
- Sedimentation	Not applicable to sludge.	Secondary
- Activated carbon	Not applicable to sludge.	Secondary
- Ion exchange	Not applicable to sludge.	Secondary
- Liquid-liquid extraction	Not applicable to sludge.	Secondary
- Oil-water separator	Not applicable to sludge.	Secondary
- Filtration	Not applicable to sludge.	Secondary
- Dissolved air flotation	Not applicable to sludge.	Secondary
o Solids handling and treatment		
- Dewatering	May be useful as pretreatment for other technologies.	Secondary
- Solvent extraction	Results in solid residue essentially ready for capping (potentially requiring stabilization) and separate oil and water streams.	Primary
D. <u>Land Disposal/Storage</u>		
o Soil Mixing	Similar to some stabilization options	Primary
o Landfills	Possible treated sludge disposal.	Secondary
o Surface impoundments	May be used with some options, but but not a key technology.	Secondary
o Land application	Similar to soil aeration but not as agressive. Uses large soil area and does not end with capping.	Not Used
o Deep well injection - off-site only	Not applicable to sludge.	Not Used
o Temporary storage	May be used with some options, but not a key technology.	Secondary

Another alternative which minimizes the need for long-term management is on-site Incineration. Under incineration, the organic constituents of concern are substantially destroyed. However, the metals contained within the matrix are concentrated and remain in the ash residue from the incinerator.

In summary, applying the technologies outlined in Section 4.0 to the guidelines on the range of remedial actions to be evaluated, the following alternatives were developed for further consideration:

- No Action
- Limited Action
- Soil Mixing
- Landfill/Vault
- Stabilization
- Land Treatment
- Aqueous Biotreatment
- Composting
- Solvent Extraction
- Incineration

5.2 Remediation Work Common To All Alternatives

With the exception of the No Action and Limited Action alternatives, all alternatives include the following common work elements:

1. Plug some wells installed for remedial investigations.
2. Control potentially contaminated stormwater run-off during remediation, and monitor quality of discharge.
3. Measure quality of ground water and stormwater discharge for 30 years in a monitor well network. The monitoring schedule may be less frequent for certain alternatives and more frequent for others.
4. Install flexible spur jetty river bank erosion control system.
5. Install temporary office/lab/supply buildings for remediation work.
6. Install temporary water, wastewater, and electric utilities for remediation work.
7. Build all-weather access and post-closure inspection roads.

and provide the needed structural strength to allow construction of the cap. These requirements provide the basis for the Soil Mixing Alternative. The Soil Mixing Alternative satisfies all ARARs and would be protective of human health and the environment.

Soil Mixing with a clay rich soil would provide sufficient structural strength to allow cap construction. However, over time it may not sufficiently reduce the mobility of organic constituents within the sludge. Consequently, all additional alternatives involve some further treatment of the sludge prior to installation of the cap. The first additional treatment alternative uses stabilizing agents added to the pond sludge to chemically fix or solidify the constituents prior to installation of the cap. Stabilization will immobilize the constituents and minimize the potential for subsequent leaching.

As an alternative to mixing soil with the sludge within the main pond area, the sludge could be removed, stabilized and placed into a new landfill cell or vault. Thus, an alternative that would involve construction of such a landfill cell is also developed and evaluated.

Three alternatives are developed which rely principally on biological degradation processes. These include aqueous biological treatment, solid phase biological treatment (i.e., land treatment) and composting. In these alternatives, biological degradation and volatilization would degrade or remove the more mobile compounds contained within the waste matrix. Certain compounds, such as PCBs, would be more difficult to degrade. Even if not degraded, however, the potential for mobility of these compounds would be reduced through elimination of the more mobile constituents in the waste matrix. This result would also potentially enhance the long-term effectiveness of stabilization since the more mobile constituents, which are more difficult to stabilize, would be removed from the matrix prior to stabilization.

One alternative was developed that utilizes alternative treatment or resource recovery technologies. This alternative is Solvent Extraction. Solvent Extraction is a rather new process in terms of its utilization at waste sites. Its efficiencies have yet to be demonstrated on a heterogeneous waste stream like that found at the Sheridan site. The solvent extraction process involves the generation of a water, oil and solid phase stream following the extraction process. The heavier organics of concern, principally PCBs, are separated out and concentrated in the oil phase. This oil phase then would undergo further treatment either through incineration or chemical dechlorination. Solvent Extraction will minimize the need for long-term management.

8. Install temporary vehicle and personnel decontamination facilities for remediation work.

9. Maintain security during remedial work.

10. Decontaminate, disassemble and properly dispose of all on-site tanks and processing equipment.

11. Build an engineered cap over the main pond and dike.

12. Monitor air and weather as necessary.

13. Coordinate with appropriate governmental agencies concerning community relations.

14. Maintain cap.

15. Establish institutional controls to prevent water supply wells from being screened in the shallow ground water between the main pond and the Brazos River.

The preliminary procedures for remediation of drums when uncovered are as follows: 1) Ruptured drums will have the remainder of their waste emptied; the drum will be shredded or crushed for mixture with wastes. 2) Sound drums will be removed intact, sampled and analyzed; the drum contents will either be treated or mixed with wastes.

5.3 Remedial Alternatives

The following pages contain fact sheets for each alternative.

o <u>Alternative 1 - No Action</u>

Sequence of Work

1. Install additional ground water monitor wells, as necessary

2. Monitor ground water

Discussion

This alternative provides for maintaining the site at its current condition and for monitoring environmental impacts. However, with no action, future site conditions are not effectively addressed.

o <u>Alternative 2 - Limited Action</u>

Sequence of Work

1. Construct erosion control device along the Brazos River

2. Install additional ground water monitor wells, as necessary, and monitor ground water

3. Install and maintain site security fence

4. Periodically remove and/or treat accumulated pond water

5. Monitor ground water

Discussion

This alternative provides fencing and site security as the mechanism to control direct human contact. In addition, pond water removal and/or treatment and erosion controls are incorporated to minimize potential for future releases.

o <u>Alternative 3 - Soil Mixing</u>

Sequence of Work

1. Construct an erosion control device along the Brazos River

2. Remove free standing water from pond

3. Mix sludge with clay-rich soil to a bearing capacity sufficient to support a cap and place within liner system in main pond

4. Backfill pond, grade to promote drainage, and cap

5. Grade evaporation system to promote run-off

6. Seed entire site with native grasses

7. Install additional ground water monitor wells as necessary and monitor ground water

8. Maintain the cap

Discussion

The pond water is removed and/or treated and discharged. Water treatment may consist of oil/water separation, clarification, carbon adsorption or biological treatment. The sludge is mixed with clay-rich soil at a ratio sufficient: 1) to assure no free liquids, and 2) provide structurally stable foundation for the landfill cap. The liner system within the main pond is a double liner with leachate collection capability. The pond is then filled with soil and an engineered cap constructed over the entire pond and dike area. The cap is then maintained.

o Alternative 4 - Landfill/Vault

Sequence of Work

1. Construct an erosion control device along the Brazos River
2. Construct an on-site landfill
3. Remove free standing water from pond
4. Stabilize sludge and place in landfill
5. Backfill pond, grade to promote drainage, and cap
6. Grade evaporation system to promote run-off
7. Seed entire site with native grasses
8. Install additional ground water monitor wells as necessary and monitor ground water
9. Maintain the cap

011002

Discussion

The pond water is removed and/or treated and discharged. Water treatment may consist of oil/water separation, clarification, carbon adsorption, or biological treatment. The sludge is removed, stabilized and placed in the landfill. The pond is then filled with soil and an engineered cap constructed over the entire pond and dike area. The cap is maintained.

o Alternative 5 - Stabilization

Sequence of Work

1. Construct an erosion control device along the Brazos River
2. Remove free standing water from pond
3. Chemically stabilize sludge and place within liner system in main pond
4. Backfill pond, grade to promote drainage, and cap
5. Grade evaporation system to promote run-off
6. Seed entire site with native grasses
7. Install additional ground water monitor wells as necessary and monitor ground water
8. Maintain the cap

011003

Discussion

The pond water is removed and/or treated and discharged. Water treatment may consist of oil/water separation, clarification, carbon adsorption or biological treatment. The sludge is stabilized and placed in a lined portion of the main pond. Chemical agents are utilized to stabilize the sludge and thereby reduce mobility and toxicity. Stabilization will be performed within the boundaries of the pond utilizing construction techniques that will assure adequate mixing. The liner system in which the stabilized material is placed is a double liner with leachate collection capability. The pond is then filled with soil and an engineered cap constructed over the entire pond and dike area. The cap is then maintained.

o <u>Alternative 6 - Land Treatment</u>

Sequence of Work

1. Construct an erosion control device along the Brazos River
2. Remove free standing water from pond
3. Isolate sludge
4. Construct land treatment area
5. Land treat sludge
6. Backfill pond, grade to promote drainage, and cap
7. Grade evaporation system to promote run-off
8. Seed entire site with native grasses
9. Install additional ground water monitor wells as necessary and monitor ground water
10. Maintain the cap

Discussion

The pond water is removed and/or treated and discharged. Water treatment may consist of oil/water separation, clarification, carbon adsorption or biological treatment. The sludge is land treated. Land treatment is utilized to biodegrade sludge organic compounds and immobilize sludge constituents. Land treatment of sludge is performed in batches. Excess storm water run-off from treatment area is treated and discharged. Following each batch, the treatment zone is compacted in place and soil is hauled in for treatment of the next batch. The pond is then filled with soil and an engineered cap constructed over the entire pond and dike area. The cap is then maintained.

o Alternative 7 - Aqueous Biotreatment

Sequence of Work

1. Construct an erosion control device along the Brazos River
2. Biotreat sludge in-situ or in tanks
3. Stabilize biological solids and place within liner system in main pond, if required
4. Backfill pond, grade to promote drainage, and cap
5. Grade evaporation system to promote run-off
6. Seed entire site with native grasses
7. Install additional ground water monitor wells as necessary and monitor ground water
8. Maintain the cap

01100S

Discussion

The pond water is removed and/or treated and discharged. Water treatment may consist of oil/water separation, clarification, carbon adsorption or biological treatment. The biodegradation step is conducted in an aqueous suspension in the pond or in mixing tanks. It is anticipated that the sludge volume will be significantly reduced by biotreatment. More importantly, the light hydrocarbon fraction is removed from the sludge leaving behind a tar-like substance which can be stabilized to immobilize any constituents not removed by biotreatment. If the representative PCB concentration of the biologically treated residue exceeds 50 PPM, the stabilized residue is placed in a lined portion of the main pond. The liner system in which the stabilized material is placed, if required, is a double liner with leachate collection capability. The aqueous stream would be treated as necessary and discharged. The pond is then filled with soil and an engineered cap constructed over the entire pond and dike area. The cap is then maintained.

o <u>Alternative 8 - Composting</u>

Sequence of Work

1. Construct erosion control device along the Brazos River
2. Remove free standing water from pond
3. Isolate sludge
4. Construct composting pad within main pond
5. Compost sludge
6. Backfill pond area, grade to promote drainage, and cap
7. Grade evaporation system to promote run-off
8. Seed entire site with native grasses
9. Install additional ground water monitor wells as necessary and monitor ground water
10. Maintain the cap

Discussion

The pond water is removed and/or treated and discharged. Water treatment may consist of oil/water separation, clarification, carbon adsorption or biological treatment. Sludge is mixed with a compost medium such as wood chips and possibly a selected fungus. The mixture is then composted until degradation is nearly complete. The composted waste is bulked with soil in the pond and an engineered cap constructed over the entire pond and dike area. Biodegradation continues, albeit slowly, after the cap is in place. The cap is then maintained.

o <u>Alternative 9 - Solvent Extraction</u>

Sequence of Work

1. Construct an erosion control device along the Brazos River
2. Remove free-standing water from pond
3. Transfer sludge for classification and blending
4. Solvent extract sludge
5. Incinerate oil residuals in an on-site or off-site liquids injection incinerator
6. Treat and discharge water
7. Stabilize and dispose of solids residuals in the main pond and transfer ash to an off-site landfill
8. Backfill pond, grade to promote drainage, and cap
9. Grade evaporation system to promote run-off
10. Seed entire site with native grasses
11. Install additional ground water monitor wells as necessary and monitor ground water
12. Maintain the cap

Discussion

The pond water is removed and/or treated and discharged. Water treatment may consist of oil/water separation, clarification, carbon adsorption or biological treatment. Solvent extraction is used to segregate the sludge into oil, water and solids residuals. The oil residuals are then incinerated on or off-site. Incinerator ash is disposed of in an off-site landfill. The solid residuals are stabilized as necessary and placed in the main pond. Water residuals are treated as necessary and discharged. The pond is then filled with soil and an engineered cap constructed over the entire pond and dike area. The cap is then maintained.

o Alternative 10 - Incineration

Sequence of Work

1. Construct an erosion control device along the Brazos River
2. Remove free standing water from pond
3. Transfer sludge for classification and blending
4. Incinerate sludge
5. Dispose of ash in an off-site landfill
6. Backfill pond, grade to promote drainage, and cap
7. Grade evaporation system to promote drainage
8. Seed entire site with native grasses
9. Install additional ground water monitor wells as necessary and monitor ground water
10. Maintain the cap

Discussion

The pond water is removed and/or treated and discharged. Water treatment may consist of oil/water separation, clarification, carbon adsorption or biological treatment. An on-site rotary kiln incinerator is constructed to incinerate the sludge. Sludge is blended in an attempt to ensure a relatively uniform feed to the incinerator. Incinerator ash is disposed of in an off-site landfill. The pond is then filled with soil and an engineered cap constructed over the entire pond and dike area. The cap is then maintained.

5.4 Initial Screening

Following assembly of these ten remedial alternatives, each alternative was evaluated on the basis of effectiveness, ease of implementation, and preliminary costs. On the basis of this evaluation, four alternatives were rejected. The rationale for rejecting these alternatives is provided in the following paragraphs:

Alternative 2 - Limited Action

> This alternative effectively addresses all the risk-based remedial objectives. However, it was judged not to be completely effective since the exposed sludge would remain accessible to animals that cannot be held out by the fence and to trespassing humans. Further, this alternative does not satisfy the regulatory remedial objectives.

9001109

Alternative 4 - Landfill/Vault

> While a new landfill cell could be designed and constructed, this alternative would result in the creation of a new waste management area in addition to the main pond area. Additional materials handling would be required in transferring sludge from the main pond to the vault. These additional activities would likely result in increased short-term risks and long-term management requirements. Further, the additional cost associated with this alternative would provide little or no benefit in terms of compliance with the remedial objectives. This alternative is therefore rejected.

Alternative 6 - Land Treat

> This alternative would satisfy the risk-based and regulatory objectives and would be implementable, it would take a substantially longer period of time to implement. Further, there remain several questions as to the overall effectiveness of solid phase land treatment. From an effectiveness standpoint, aqueous biological degradation was judged more effective. Finally, this alternative could not be implemented on-site and be compliant with RCRA land treatment regulations. Therefore, this alternative was not carried forward.

Alternative 8 - Compost

Effective composting could potentially achieve compliance with the risk-based and regulatory remedial objectives. Even though composting (possibly using white rot fungus) is an innovative and promising technology, the composting process seems to be incompatible with subsequent cap placement. The volume of the compost medium and sludge mixture would be many times the volume of sludge alone, and degradation of the medium would continue after the sludge had been effectively treated. Continuing anaerobic degradation after closure would create significant voids under the cap that could cause cap settlement. Long-term aerobic composting before capping would resolve this structural concern, but would result in this alternative taking longer to implement than the other alternatives which accomplish the same thing. This alternative is therefore rejected.

011010

5.5 Summary

The following alternatives survived the preceding initial screening, and undergo detailed design analysis in the next section:

- No action
- Soil Mixing
- Stabilization
- Aqueous Biotreatment
- Solvent Extraction
- Incineration

Table 5-2

Comparison of Cost and Time to Completion

Alternative	Total Cost[a] (Million $)	Time to Completion (Years)
1. No Action	1	-
2. Limited Action	3	1
3. Encapsulation	21	2
4. Landfill/Vault	23	2
5. Stabilization	19	2
6. Land Treatment	23	8
7. Aqueous Biotreatment	28	3
8. Composting	25	8
9. Solvent Extraction	37	4
10. Incineration	40	5

[a] Total cost not discounted for interest (30 year present worth, after tax i = rate of inflation)

E720

011011

6 - DETAILED ANALYSIS OF SOURCE CONTROL ALTERNATIVES

Previous sections identified combinations of source control technologies that can be used at the SDS Site to adequately protect human health and the environment. Section 5 developed these combinations of technologies into alternatives and screened out four alternatives. This section develops further the evaluation of the surviving alternatives, and then closely compares the relative strengths and weaknesses of each alternative. The remaining alternatives are designated as follows for ease of reference:

Alternative A - No Action

Alternative B - Soil Mixing

Alternative C - Stabilization

Alternative D - Biotreatment

Alternative E - Solvent Extraction

Alternative F - Incineration

Comparisons of detailed designs of each alternative are made in terms of compliance with ARARs; reduction in toxicity, mobility or volume; short-term effectiveness; long-term effectiveness and permanence; implementability; cost; community acceptance; state acceptance; and overall protection of human health and the environment. Comparisons are based on guidance provided in a July 24, 1987 EPA memo from J. Winston Porter and are first presented in detailed narrative discussion, and summarized by a check ("."), check-plus ("+"), check minus ("-") scale. More detailed cost comparisons are then made, with sensitivity analyses based on capital cost, O&M cost, present worth discount rate, and design volume.

6.1 Design of Alternatives

A conceptual design has been developed for each surviving alternative based on the RI, RA and appended information. These designs incorporate engineering judgment, the result of bench scale testing, and experiences with comparable site remediation and solid waste management.

6.1.1 Common Design Elements

The following design basis and overall concepts are common to all alternatives with the exception of the No Action alternative.

6.1.1.1 Design Definitions

Pond Water	Free water contained within the main pond. Becomes high in solids near the surface of the pond sludge.
Sludge	Sum of the following materials containing PCBs above the action level identified in Section 3.
1. Pond Sludge	Sludge contained within the main pond.
2. Evaporation System Sludge	Sludge contained within the evaporation system.
3. Oily Surface Soil	Oily material on the surface of the main pond dikes, e.g., existing surface to a depth of six inches.
4. Floating Oil and Emulsion	Floating oil and emulsion on the pond water.
5. Affected Soil Under Pond	Soil under the pond intermixed with the pond sludge.
Soil	Borrow soil. To the extent possible, evaporation system soils are preferentially used as borrow soil for fill under a cap.
Sound Drums	Drums that have not been ruptured.
Ruptured Drums	Drums that have been damaged such that some of the contents of the drum have had opportunity to encounter the surrounding material.
Drums Holding Containers	Ruptured or sound drums that hold containers that may be sound.

011013

Affected Stormwater	Stormwater falling within the main pond or upon waste exposed by construction.
Wastewater	Decontamination water and wastewater streams from treatment processes. Does not include sanitary wastewater.
Equalization Basin	Temporary containment for pond water, affected stormwater and wastewater prior to treatment.
Wastewater Treatment	Removes solids and chemical constituents from affected stormwater and wastewater streams generated by remedial efforts.
Drainage Control	Stormwater collection and/or diversion via structures or surface grading and contouring.
Cap	Serves as a water barrier to minimize percolation of rainfall into the main pond and dike.
Topsoil and Vegetation	Protects remediated site from soil erosion by wind and rain.
Jetty System	Protects remediated site from bank erosion by the Brazos River.
Fencing and Security	Prevents unauthorized access to the site.

011014

6.1.1.2 Common Design Basis

Sludge Volume

Pond Sludge	30,000 yd^3
Affected Soil Under Pond	10,000 yd^3
Evaporation System Sludge	1,000 yd^3
Oily Surface Soil	3,000 yd^3
Floating Oil and Emulsion	300 yd^3
Total	44,300 yd^3 say 44,000 yd^3

The pond sludge volume is based on a September 1984 sample program that showed a main pond sludge depth of one to three feet, and a June 1987 sample program that showed a pond sludge depth of a little more than one foot. The pond sludge volume used as a design basis is equivalent to 12 acres of pond sludge (equal to the surface area of the water surface at el. 170.5) at an average depth of 18 inches.

The volume of affected soil under the pond is based on the same acreage, assuming an average depth of 6 inches. This depth assumption is based on experience with similar impoundments which seem to have become sealed by natural means or waste properties. The true depth of affected soil cannot be determined on the basis of existing data.

The evaporation system sludge volume used is an approximation based on visual observation. The oily surface soil is the area on the inside slope of the dike between the highest possible water surface and the lowest possible water surface to a depth of three inches. This is the area where oil has accumulated on the surface as the water surface has risen and fallen over the years.

The floating oil and emulsion volume is a June 1987 estimate, based on the fact that there were then three acres of floating oil and emulsion three-quarters of an inch thick. Most of that has since been consolidated in tanks.

<u>Cap Components</u>

Attic Fill	
- Material	- Recompacted soil
- Hydraulic Conductivity	- 10^{-5} cm/sec or less
Dike	
- Vegetation	- Native grasses
- Topsoil	- 12 in.
- Clean Fill	- Thickness varies, $\leq 10^{-5}$ cm/sec hydraulic conductivity
- Slope	- 1:3 (vertical:horizontal)
- Erosion Control	- Stormwater berm on cap directing run-off to reinforced concrete pipes.
Cap	
- Vegetation	- Native grasses
- Topsoil	- 12 in.
- Recompacted Clay	- 3 ft
- Slope	- 4%

Flood Elevations

- 25 Year Event - 171.5 ft. MSL
- 50 Year Event - 173.5 ft. MSL
- 100 Year Event - 175.0 ft. MSL

Design Elevations

- Building Floors - 25 year + 1.5 ft
- Decon Pads - 25 year + 1.5 ft
- Haul Roads - 1.0 ft. above grade
- Maintenance Roads - 2.0 ft. above grade
- Top of Main Pond Dike - 100 year + 1.5 ft

The cap design concepts are based on professional experience in the design of caps for solid waste facilities in the mid-Texas area. The flood elevations were developed in coordination with the Federal Emergency Management Agency and the U.S. Department of Army Corps of Engineers. The latter agency developed the values used in 1984 when they performed a backwater study made in preparation for the design of Millican Lake on the Navasota River.

6.1.1.3 Description of Elements Common to All Alternatives

The RA, through its evaluation of current site conditions as well as most probable future landuse conditions assuming no remedial action, identified two risks that need to be addressed by any remedial action taken at the site. The first identified risk stems from the direct contact scenario where a site visitor is assumed to contact and ingest sludges from the waste disposal areas. The risk represented by this exposure exceeded the 1 x 10^{-5} criterion selected as an appropriate risk level. The second identified risk, which was not quantified but may be significant, is the potential for long-term erosion along the Brazos River. Under all remedial alternatives, the direct contact and river bank erosion issues are dealt with by capping of the waste disposal area and installing a spur jetty system.

The first step in all alternatives, except for the No Action alternative, is to control river bank erosion over the long-term with the construction of a jetty system. River bank erosion is a natural condition observed along meandering streams such as the Brazos River. As the river bends, its channel is directed toward the "high bank" due to velocity gradients within the stream. These higher velocity currents tend to undercut the high bank, causing overburden soils to fall into the river. These soils are then redeposited downstream as channel bars and "low bank" sediments, gradually reorienting the river channel toward the direction of the high bank.

River bank erosion is minimized by the spur jetties. The spur jetty erosion control system, shown in Figure 6-1, has been engineered for the dimensions and velocities of this reach of the Brazos River. The spur jetty is constructed of panels 16 feet high and approximately 20 feet long, supported by tubular steel piling. Vertical treated planks are tied to horizontal steel pipe stringers to form the panels, which are tied to the pilings to form jetties. Spaces between the planks allow flowing water to pass through (hence these are known as "permeable" jetties), but at greatly reduced velocities.

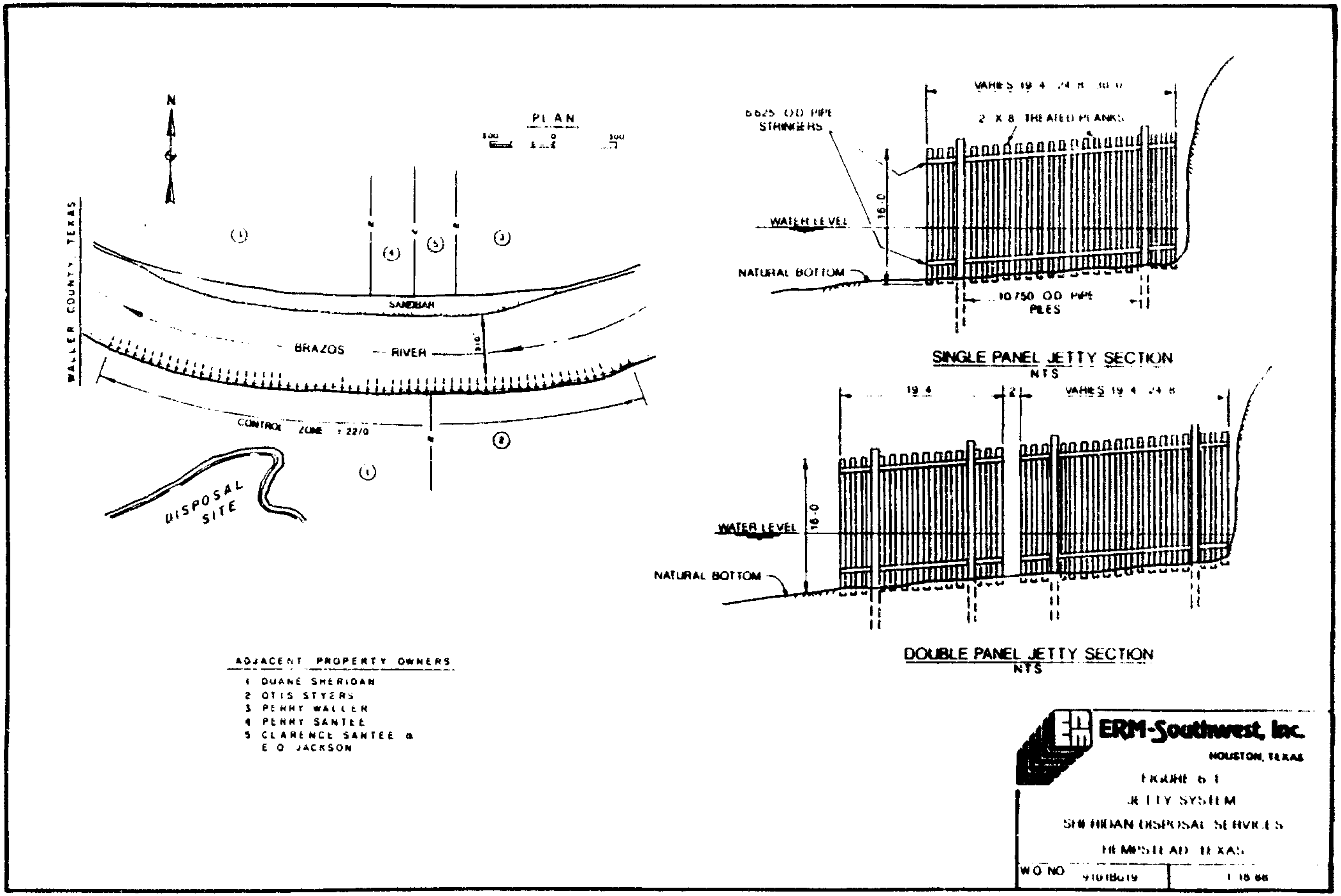
The spur jetty system reduces the velocity of water at the base of the high bank and redirects currents into the middle of the river. This prevents additional erosion and causes deposition of a protective mass of waterborne material at the base of the high bank. These spur jetty systems have been successfully used at over fifteen sites on the Brazos River since 1961.

In order to mitigate the risk posed by the direct contact concern, all alternatives involve construction of an engineered cap over the main pond and dikes. Before remediation proceeds, pond water is removed from the main pond. Pond water, wastewater and affected stormwater are treated as necessary and discharged to the Brazos River.

During remediation the perimeter of the site is fenced. Locked gates protect all entrances. Drainage controls are provided to limit run-on to affected areas and to collect affected stormwater run-off. Following remediation, ground water monitor wells are installed and ground water is monitored for 30 years.

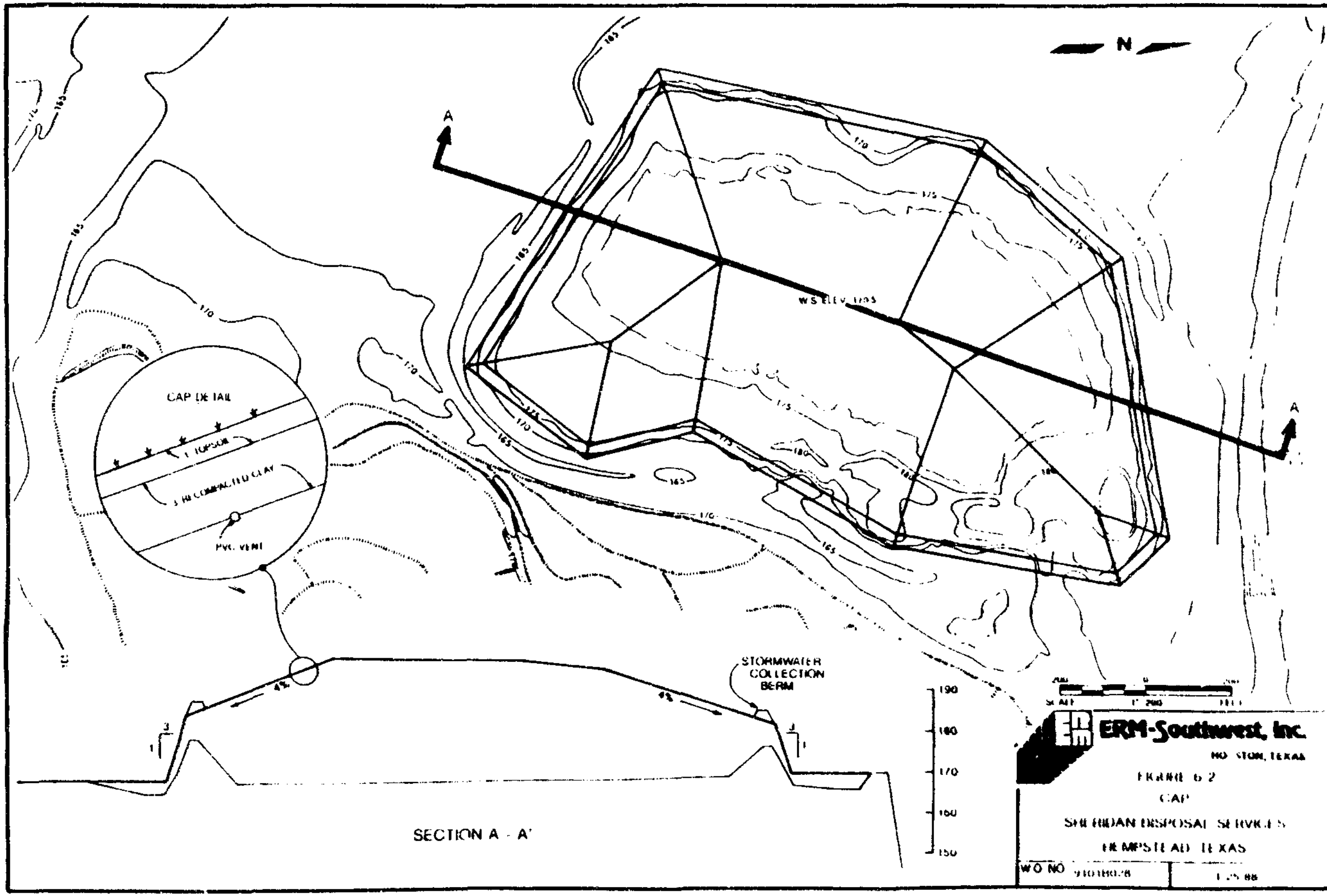
During remedial action, as drums are encountered they are classified as 1) ruptured drums, 2) sound drums and 3) drums holding containers. Ruptured drums have been damaged such that contents of the drum have had an opportunity to encounter the surrounding material; these drums are emptied and the empty drum is crushed and set aside. The contents of sound drums are characterized and the drums placed in compatible groups for treatment and on-site disposal, or alternately placed in overpack drums for off-site disposal. Containers within drums are individually classified as ruptured or sound and are generally handled in the same manner as individual drums.

The final major step in each alternative is the construction of an engineered cap placed over the main pond and dike. A representation of the cap configuration is shown in Figure 6-2. The shallow borrow area around the main pond is filled to natural grade. Soil is added as necessary to the outer flanks



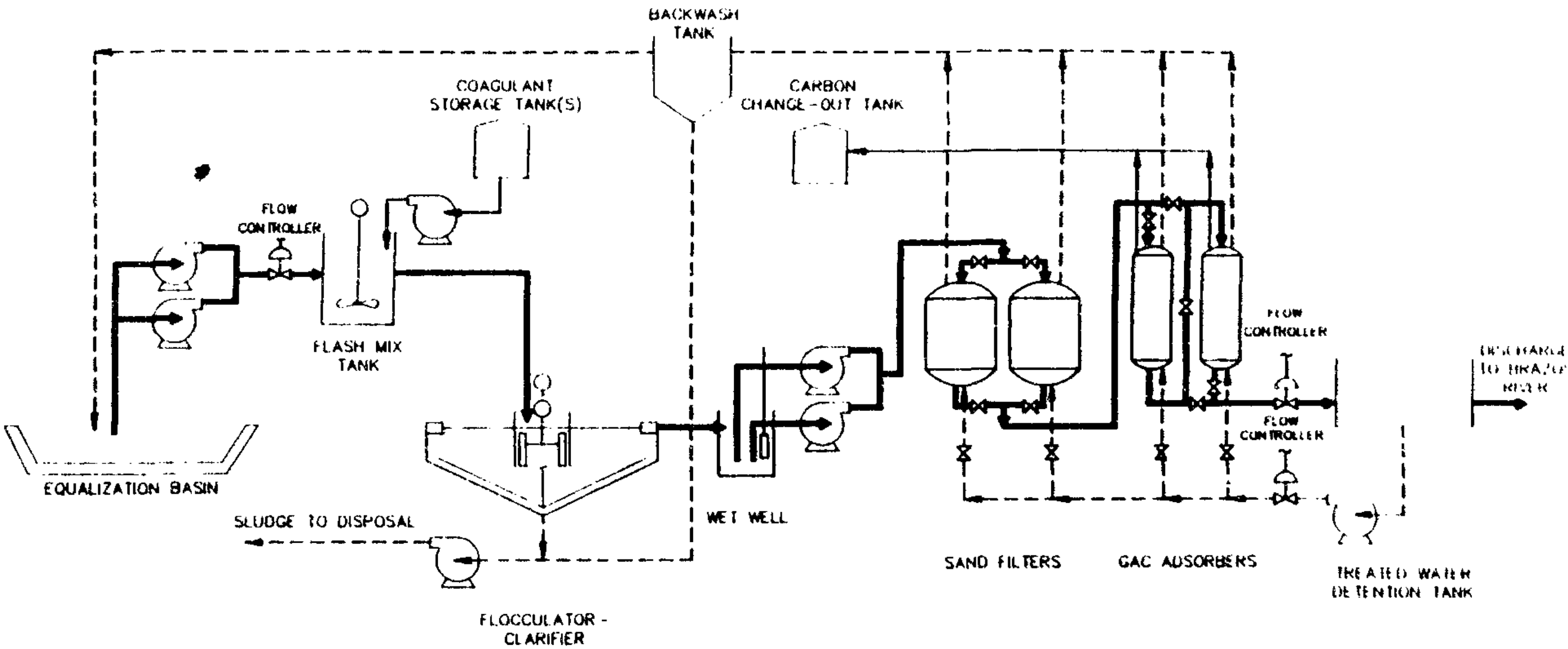
N
PLAN
WALLER COUNTY, TEXAS
SANDBAR
BRAZOS
RIVER
CONTROL ZONE ± 2270
DISPOSAL SITE
ADJACENT PROPERTY OWNERS
1 DUANE SHERIDAN
2 OTIS STYERS
3 PERRY WALLER
4 PERRY SANTEE
5 CLARENCE SANTEE & E O JACKSON
6.625 OD PIPE STRINGERS
2 X 8 TREATED PLANKS
WATER LEVEL
NATURAL BOTTOM
16.0
10.750 OD PIPE PILES
SINGLE PANEL JETTY SECTION
NTS
19.4
2
WATER LEVEL
NATURAL BOTTOM
16.0
DOUBLE PANEL JETTY SECTION
NTS
ERM-Southwest, Inc.
HOUSTON, TEXAS
FIGURE 6-1
JETTY SYSTEM
SHERIDAN DISPOSAL SERVICES
HEMPSTEAD, TEXAS
W O NO

011018


N
A
A
W S ELEV 175.5
CAP DETAIL
1' TOPSOIL
3' RE COMPACTED CLAY
PVC VENT
STORMWATER
COLLECTION
BERM
4%
4%
SECTION A - A'
190
180
170
160
150
SCALE 1" 200 FEET
ERM-Southwest, Inc.
HOUSTON, TEXAS
FIGURE 6 2
CAP
SHERIDAN DISPOSAL SERVICES
HEMPSTEAD, TEXAS
WO NO

011019

6-8



PRELIMINARY PROCESS FLOW DIAGRAM

N.T.S.

ERM-Southwest, Inc.

FIGURE 6.3

WASTEWATER TREATMENT

SHERIDAN DISPOSAL SERVICES

HEMPSTEAD, TEXAS

9101B20888 DATE 2/18/88

of the pond dike and within the main pond to form the desired design grade, and the cap is installed and maintained over the pond and dike.

The cap is a composite design of (from bottom to top) gas vent piping, recompacted clay, topsoil, and native grasses. After surface grading of the soil foundation for the cap, gas collection piping is bedded in shallow trenches. Three feet of clay is then placed and compacted in layers. One foot of topsoil is placed to provide moisture and nutrient support for a vegetative cover. Finally, native grasses are established to control erosion and to maximize evapotranspiration of percolating rainfall. Risers are added to vent collected gases, and erosion control berms are added to prevent accumulated rainfall run-off from running down the 3:1 side slopes. With proper maintenance, this cap will serve to minimize the amount of rainfall infiltration which is available to migrate through the waste and generate leachate over the long-term. This design will entail only minimum maintenance and require only annual mowing to keep trees from growing on its surface.

Finally, institutional controls will be implemented between the main pond and the Brazos River to prevent use of shallow ground water down gradient of waste sources.

6.1.2 Alternative A - No Action Alternative

Description

Alternative A, No Action, is limited to maintenance of the site in its current condition and ground water monitoring at the site for 30 years. No capital improvements are made at the site.

Overall Concepts

None	No capital improvements made at the site.

6.1.3 Alternative B - Soil Mixing

Description

Alternative B, Soil Mixing, includes mixing clay-rich soil with the sludge to provide a mixture which is structurally stable and produces no free liquid, even when compacted. Prior to this step, pond water is removed and either evaporated or treated as necessary and discharged. Figure 6-3 presents a preliminary concept design for wastewater treatment. Sludge is mixed with clay-rich soils from the site to create an oil-water-soil matrix, and placed within a liner system in the main pond.

The mixing of soils with sludges and subsequent compaction provides a structurally stable base for the engineered cap. This mixing will reduce the mobility and toxicity of the waste constituents. Mobility of constituents within the sludge will be reduced by a complex system of physical and chemical reactions between soil minerals and metals and organic waste constituents.

<u>Overall Concepts</u>

Soil Mixing	Blends the sludge with clay-rich soil to form a compacted soil-water-oil mixture.
Liner System	Controls potential leachate migration from treated waste materials, and allows monitoring of remedy effectiveness.

<u>Design Basis</u>

Mixing Ratio (estimated)	6:1 (soil:sludge)
Mixed Material	
Moisture Content	25%, dry weight basis
Oil Content	6-9%
Liner System	
Drainage Layer	12 in. sand, slotted HDPE pipe
Flexible Membrane Liner	60 mil HDPE
Drainage Layer	12 in. sand, slotted HDPE pipe
Flexible Membrane Liner	60 mil HDPE
Recompacted Clay	$\leq 10^{-7}$ cm/sec hydraulic conductivity
Construction Period	2 years

The mixing ratio of 6:1 (soil:sludge) is based on an analysis of Proctor moisture-density curves and the percent of oil and grease in asphalt. It should result in a material with significant structural strength and low permeability. Evaporation system sludge, oily surface soil and affected soils under the pond, all substantially soil and sludge mixtures, are mixed at a ratio of only 2:1. These mixing ratios are estimates and would have to be confirmed through further testing.

Volumes of Waste and Wastewater

Waste	
Initial Volume	44,000 cubic yard
Final Volume after Mixing with Soil	215,000 cubic yards
Wastewater	32 million gallons (160,000 cubic yards)
Disposition	
Evaporation	10 million gallons
Treatment and Discharge	22 million gallons

Note: More detailed volume calculations are in Appendix F.

6.1.4 Alternative C - Stabilization

Description

Alternative C, Stabilization, involves chemical stabilization of the sludge by mixing stabilization materials with sludge in the main pond and placement within a liner system in the main pond. Backfilled clays are added over the stabilized mass prior to capping the main pond. Also see Appendix D - Stabilization and Solvent Extraction Report.

The term "Stabilization" as used in this report includes the treatment process of solidification, stabilization and fixation, and generally refers to waste treatment processes that make the waste easier to handle, decrease the surface area of the waste mass across which transfer or loss of waste constituents can occur, and limit the solubility of the waste constituents. Stabilization includes a variety of pozzolanic and cementatious processes that have been developed to incorporate dissolved constituents in wastes and sludges into a rigid matrix. Heavy metals react to form immobile colloidal hydroxides and large organic molecules become effectively immobilized. Smaller organic molecules are more difficult to maintain within the stabilized matrix.

The concern that light organics have the potential to mobilize heavy organics which are otherwise physically trapped in the stabilized waste matrix must be further evaluated. Such further testing will be performed.

The stabilization process will be designed for long-term integrity. The physical and chemical reactions of stabilization could be reversed by desorption, by biodegradation, or by dissolution of the waste matrix, all caused by percolating moisture. However, with adequate maintenance, the engineered clay cap will control percolating moisture, and the stabilized materials will, by design, have a pH which will preclude biological activity.

<u>Overall Concepts</u>

Stabilization	Increases the strength of the waste for handling, trafficability and structural support. Limits the solubility and mobility of the waste constituents.
Liner System	Controls potential leachate migration from treated waste materials, and allows monitoring of remedy effectiveness.

<u>Design Basis</u>

Stabilization	
Volume Increase	
Pond Sludge	20%
Affected Soil	20%
Unconfined Compressive Strength	15 psi minimum
Liner System	
Drainage Layer	12 in. sand, slotted HDPE pipe
Flexible Membrane Liner	60 mil HDPE
Drainage Layer	12 in. sand, slotted HDPE pipe
Flexible Membrane Liner	60 mil HDPE
Recompacted Clay	$\leq 10^{-7}$ cm/sec hydraulic conductivity
Construction Period	2 years

An unconfined compressive strength of 15 psi after 24 hours is used as a design criteria based on conversations with stabilization vendors. This will enable earth-moving equipment to move over the stabilized mass within 24 hours of its having been placed and will greatly expedite the stabilization of the pond sludge. An additional design basis for stabilization will be a yet undefined leachate performance criteria.

Volumes of Waste and Wastewater

Waste	
Initial Volume	44,000 cubic yards
Volume After Stabilization	53,000 cubic yards
Wastewater	32 million gallons (160,000 cubic yards)
Disposition	
Evaporation	10 million gallons
Treatment and Discharge	22 million gallons

Note: More detailed volume calculations are in Appendix F.

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6.1.5 Alternative D - Biotreatment

Description

Alternative D, Biotreatment, involves aqueous biological treatment in tanks or impoundments. While tanks are used in the design of this alternative, the selection between tanks outside of the main pond and impoundments within the main pond would be made during design. Long-term biotreatment, a process designed to degrade PCBs in addition to other organics, is not fully demonstrated at this time and is not carried forward in this evaluation. Based on bench scale tests to date, short-term biotreatment could be used to effectively reduce the concentrations of volatile and semivolatile organic constituents in the sludge and produce a residue which should be suitable for stabilization. Biotreatment is expected to reduce the volume of the sludge by up to 50%, mainly due to dewatering. Further testing will be performed to evaluate both long-term and short-term biotreatment. Results of this additional testing will be incorporated into the Final FS. For purposes of design, a 30 day residence time is assumed to be more than adequate to remove the majority of the volatile and mobile semivolatile compounds, and produce a residue suitable for stabilization.

In this alternative, biotreatment and stabilization are used together to couple the demonstrated ability of the biotreatment process, volatilization and biodegradation, to remove light organics and by stabilization to immobilize heavy organics and heavy metals.

This alternative begins with the transfer of pond sludge and other oily materials to treatment tanks (Figure 6-4). Treatment tanks are constructed outside the main pond. The tank system has the capability of receiving sludge in a 10% sludge concentration (approximately 5% dry solids concentration) with pond water, aerating the mixture, cleaning the off-gasses, and collecting the solids. Free liquid will be drained from the biotreatment solids on sludge drying beds. Pond sludge and floating oil and emulsion are pumped to the treatment tanks in batches for biological treatment. Treatment residues are stabilized prior to being placed in the main pond. Stabilized material containing greater than 50 ppm PCB's will be placed within a liner system. Affected soils under the pond undergo biological treatment in this alternative if above the 25 ppm PCB action level.

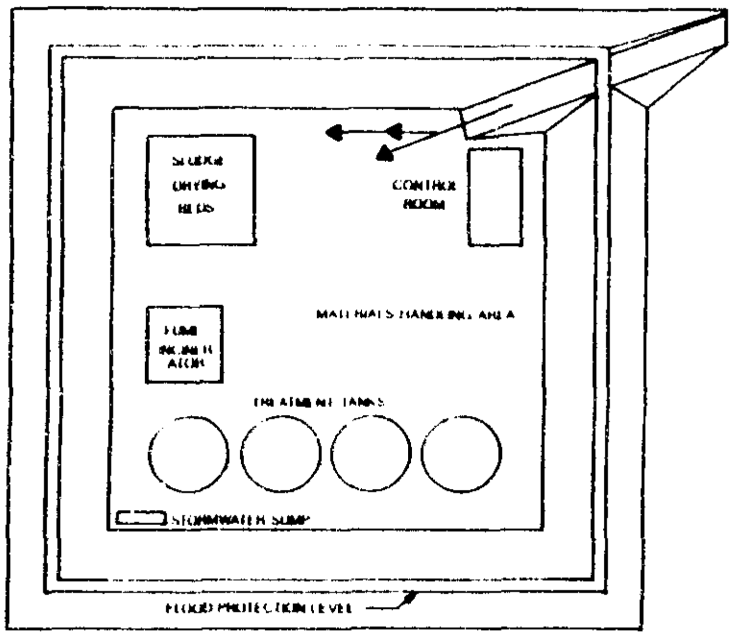
Off-gases from biological treatment may have significant concentrations of light organics and will be treated to control air pollution. The design used herein includes a fume incinerator for this purpose, but flares, carbon adsorption and other means would be evaluated in design phase.

<u>Overall Concepts</u>

Biotreatment	Use of suspended growth completely mixed aerobic reactors to promote biological degradation of sludge organic constituents.
Stabilization of Residual Solids	Limits the mobility of any constituents remaining after treatment.
Liner System	Controls potential leachate migration from treated waste materials, and allows monitoring of remedy effectiveness.

<u>Design Basis</u>

Treatment Tanks	
Number	4
Volume	740,800 gal ea
Freeboard	2 ft
Diameter	82 ft
Side Water Depth	18 ft



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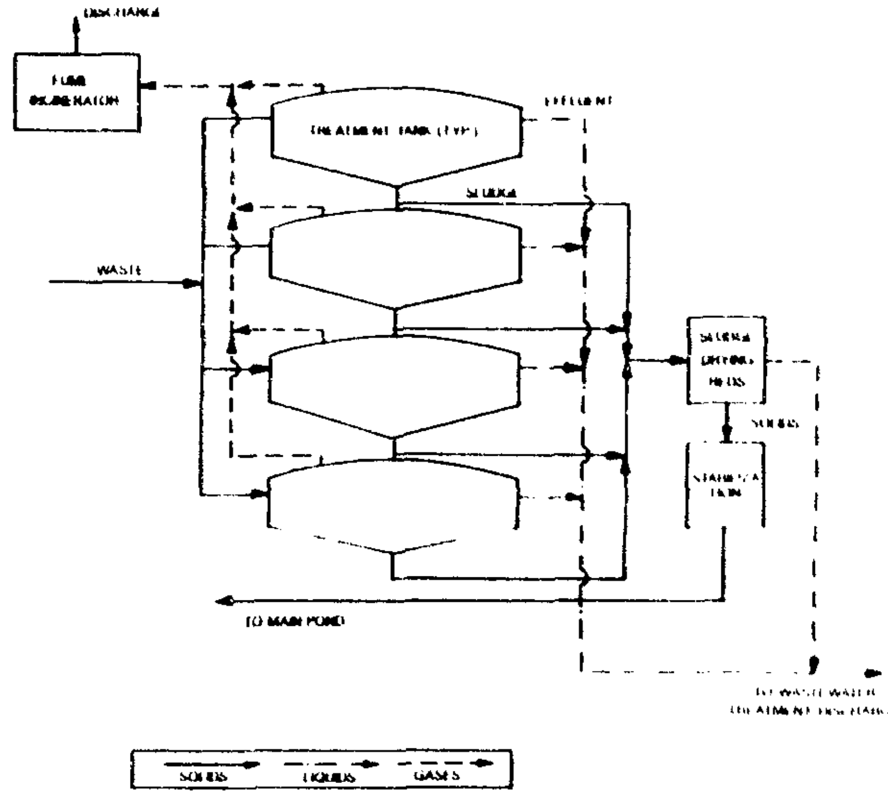

GENERAL FLOW DIAGRAM

ERM-Southwest, Inc.
HOUSTON, TEXAS

FIGURE 6 4
TANK BIOTREAT FACILITIES
SHERIDAN DISPOSAL SERVICES
HEMPSTEAD, TEXAS

W.O. NO. 910180111 | 5 18 88

Aerators	
Number	2
Size	25 hp (1 HP/1000 cf)
Solids Mixing	Grinder Pump
Treatment Batches	
Time Period per Batch	30 days + 6 days turnaround
Number of Batches	30 (1 batch = 4 tanks)
Air Pollution Control	
Type	Fume Incinerator
Air Flow	800 cfm
Biotreatment Volume Decrease	
Pond Sludge, Emulsion	35%
Affected Soils	25%
Stabilization Volume Increase	20%
Liner System	
Drainage Layer	12 in. sand, slotted HDPE pipe
Flexible Membrane Liner	60 mil HDPE
Drainage Layer	12 in. sand, slotted HDPE pipe
Flexible Membrane Liner	60 mil HDPE
Recompacted Clay	$\leq 10^{-7}$ cm/sec hydraulic conductivity
Construction Period	3 years

Volumes of Waste and Wastewater

Waste and Wastewater Volumes

Waste	
Initial Volume	44,000 cubic yards
Final Volume After Biotreatment and Stabilization	36,000 cubic yards
Wastewater	44 million gallons (220,000 cubic yards)

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Disposition

Evaporation	25 million gallons
Treatment and Discharge	19 million gallons

Note: More detailed volume calculations are in Appendix F.

6.1.6 Alternative E - Solvent Extraction

Description

Alternative E, Solvent Extraction, involves physical/chemical separation of sludge and other oily material into oil, water, and solids and subsequent treatment of each of the extracted phases. Sludge is transferred to an extraction plant located immediately outside the main pond (Figure 6-5) for separation. The oil fraction is burned in an on-site liquids injection incinerator. The water fraction is treated and discharged. The solids fraction is stabilized and disposed of in the main pond.

Note that solvent extraction is an innovative technology that has been utilized at only one CERCLA site to date. Although solvent extraction is a named technology, it is intended to be a generic term for the separation of oil, water and solids into separate fractions for subsequent treatment.

The solvent extraction system is constructed within flood protection dikes outside the main pond along with a liquids injection incinerator. The solvent extraction system will have to have the capability of receiving a heterogeneous waste stream containing debris, and producing: 1) clean debris, 2) oil free of solids and water, 3) water suitable for discharge after treatment (with pretreatment to lower pH and to reduce oil and grease) with stormwater runoff and 4) dry solids.

Sludge is isolated at one end of the main pond. Sound drums are set aside during sludge isolation and are analyzed with drum contents discharged into the sludge or placed in compatible high strength waste tanks. Sludge is pumped and hauled to the solvent extraction facility in batches for treatment. Clean debris is crushed and placed in the main pond. Oil is placed in a heated tank then burned in the liquids injection incinerator. The incinerator is provided with adiabatic quench for cooling and a caustic scrubber for adsorption of acid gasses before the flue gas is discharged to the atmosphere. Water is discharged after filtration and carbon adsorption. Dry solids are stabilized and placed in the main pond. Ash from incineration is landfilled off-site.

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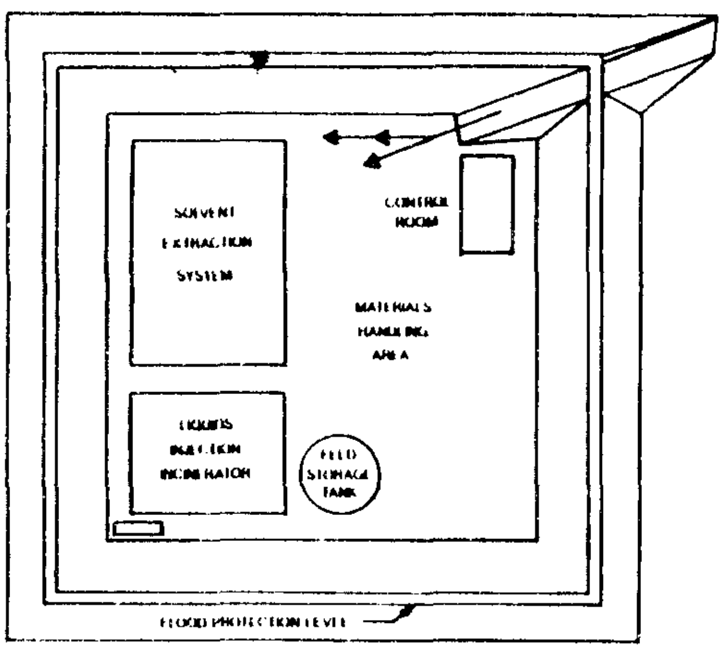

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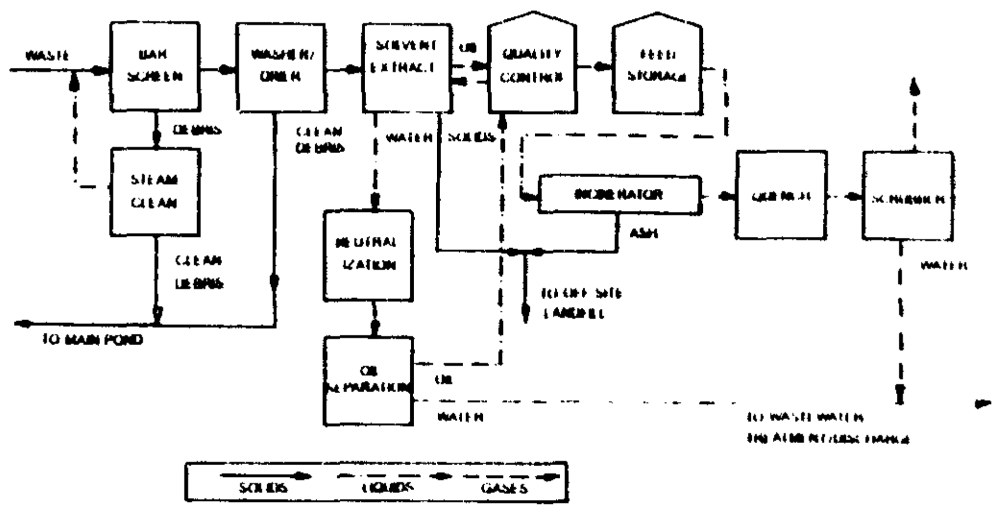

GENERAL FLOW DIAGRAM

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FIGURE 6 5
SOLVENT EXTRACTION AND INCINERATOR FACILITIES
SHERIDAN DISPOSAL SERVICES
HEMPSTEAD TEXAS

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Overall Concepts

Solvent Extraction	Produces clean debris, oil and water, dry solids from a heterogeneous waste stream.
Incineration	Destroys most liquid organic waste and waste constituents, but not metals.

Design Basis

Solvent Extraction Facilities	
Solvent	Aliphatic Amine
Separation	Centrifuge
Equalization	Day tanks
Wastewater Pretreatment	Neutralization, oil separation
Capacity	130 ton/stream day
Utilization	60% on-line
Heated Storage	
No. Tanks	1
Size	5000 gal
Recirculation Pumps	2 at 3 HP ea
Boiler	300 lb/hr low pressure steam
Heat Exchangers	2 at 131,000 BTU/hr ea
Fuel	Natural Gas
Standby Fuel	Oil
Incinerator	
Number	1
Type	Liquid Injection
Heat Release	30 million BTU/hr
Dimensions	6.6 ft ID by 50 ft length
Feed	250 gal/hr
Air Pollution Control	
Adiabatic Quench Tower	15 ft packed tower
Caustic Scrubber	25 ft packed tower
Auxiliary Fuel	Natural Gas
Standby Fuel	Oil
Utilization	85% On-Line
Construction Period	4 years

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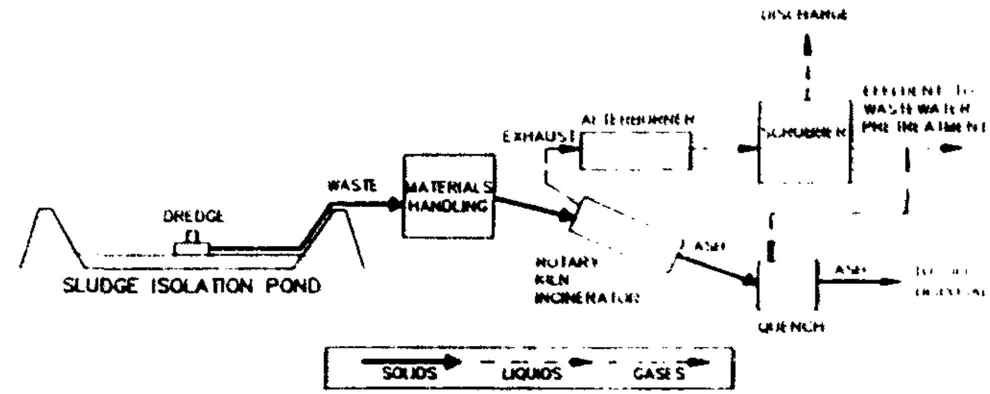
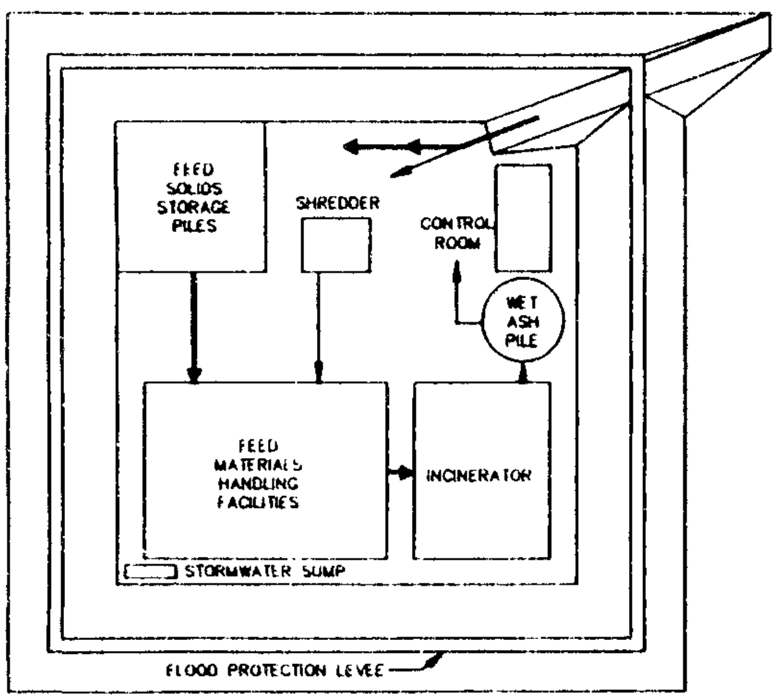
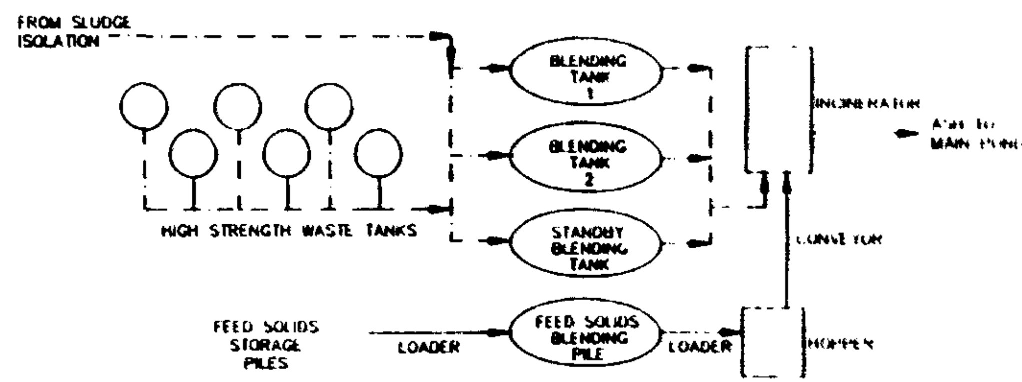


GENERAL FLOW DIAGRAM





FEED MATERIALS HANDLING FLOW DIAGRAM

LAYOUT

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FIGURE 6-6

INCINERATOR FACILITIES

SHERIDAN DISPOSAL SERVICES

HEMPSTEAD, TEXAS

W.O. NO. 91019021888 | DATE 2/09/88

A 60% utilization factor is used for solvent extraction because it is still developmental in nature. The liquids injection incinerator is needed to operate at 85% utilization when the solvent extraction system is fully operational, but the combined systems will be only 60% operational.

Volumes of Waste and Wastewater

Waste and Wastewater Volumes

Waste	
Initial Volume	44,000 cubic yards
Final Volume of Residual Solids After Stabilization	22,000 cubic yards
Wastewater	72 million gallons (360,000 cubic yards)
Disposition	
Evaporation	10 million gallons
Treatment and Discharge	62 million gallons

Note: More detailed volume calculations are in Appendix F.

6.1.7 Alternative F - Incineration

Description

Alternative F, Incineration, begins with on-site construction of a rotary kiln incinerator (or another incinerator with good solids handling capability) which has waste handling and blending facilities, ash handling facilities and air pollution control facilities (Figure 6-6). Waste handling facilities typically include a dredge, blending tanks, a drum shredder, a wood chipper, a solids storage pile, a solids feed hopper, high strength waste tanks, and associated pumps and piping. See also Appendix E - Review of Incineration Technologies and Preliminary Bases of Design.

Sludge is isolated at one end of the main pond. Sound drums are set aside during sludge isolation and are analyzed with drum contents discharged into the sludge or placed in compatible high strength waste tanks. Shredded drums, lumber, concrete, pipe and other debris are handled with the soil wastes.

The sludge is blended and supplemented with drum contents, shredded drum carcasses and shredded debris to provide a relatively consistent feed to the incinerator. Ash from the incinerator is hauled off-site for disposal. The main pond will be filled with compacted soil before capping.

<u>Overall Concepts</u>

Incineration	Destroys most organic waste and waste constituents, but not metals.
Sludge Isolation	Blends pond sludge. Allows drummed waste consolidation before incineration.
Materials Handling	Attempts to achieve uniform feed of sludge and solids to incinerator. Attempts to handle wide variety of materials to be incinerated.

<u>Design Basis</u>

Materials Handling Facilities

Blending Tanks	
Number	3
Type	Covered, Mixed
Volume	12,000 gallons (60 yd^3)
Solids Stockpiles	
Number	1
Volume	50 yd^3
Type	Uncovered, above ground clay pad
High Strength Waste Tanks	
Number	6
Type	Covered, Mixed
Volume	5000 gallons each
Liquids Handling Equipment	Dredge in Main Pond Positive Displacement Pumping
Solids Handling Equipment	Shredder Wheeled Loader Hopper-Conveyor

Incinerator	
Number	1
Type	Rotary Kiln
Size	7 ft ID
Scrubber	Ionizing Wet Scrubber
Fuel	Natural Gas
Standby Fuel	Oil
Feed Design Capacity	4820 lb/hr (58 tons/day)
Feed Maximum Capacity	6030 lb/hr (72 tons/day)
Utilization	75% On-Line
Construction Period	5 years

Incineration alternatives must meet the following performance goals:

A. Those provided by RCRA and 40 CFR 264.343, and

B. TSCA regulations for PCBs and 40 CFR 761.70

The above design criteria for materials handling facilities are based on professional judgment and a knowledge of the extreme variability of the waste physical and chemical characteristics.

To the degree possible, sufficient facilities have been included to reflect as accurately as possible the considerable cost of the difficult materials handling needed to support incineration.

<u>Volume of Waste and Wastewater Volumes</u>

Waste	
Initial Volume	44,000 cubic yards
Final Volume After Incineration	12,000 cubic yards ash.
Wastewater	82 million gallons (400,000 cubic yards)
Disposition	
Evaporation	10 million gallons
Treatment and Discharge	72 million gallons

Note: More detailed volume calculations are in Appendix F.

It is assumed that scrubber water will require some pretreatment before it can be treated with other wastewaters generated at the site.

6.2 Comparative Evaluation of Alternatives

6.2.1 Comparative Evaluation Criteria

Having defined in more detail the six surviving alternatives, this section of the FS subjects each alternative to a comparative evaluation. This comparative evaluation is conducted on the basis of nine factors or criterion. These criteria include: (1) Consistency with ARARs; (2) Reduction in mobility, toxicity or volume; (3) Short term effectiveness; (4) Long term effectiveness and permanence: (5) Implementability; (6) Cost; (7) Community acceptance; (8) State acceptance; and (9) Overall protection of human health and the environment.

The considerations relevant to the comparative evaluation for each of these nine criterion are outlined below, followed by the detailed evaluation of the relative strengths and weaknesses of the various alternatives on the basis of these considerations.

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1. Consistency with ARARs

   In determining appropriate remedial actions at Superfund sites, consideration is given to the requirements of other Federal and State environmental laws, in addition to CERCLA as amended by SARA. Primary consideration is given to attaining applicable or relevant and appropriate Federal and State public health and environmental laws and regulations and standards. Not all Federal and State environmental laws and regulations are applicable to each Superfund response action. Section 3 describes those ARARs specific to the Sheridan site. Section 6.2.3 evaluates the degree to which the selected alternates comply with these ARARs.

2. Reduction in Toxicity, Mobility or Volume

   The degree to which alternatives employ treatment that reduces toxicity, mobility or volume is assessed. Relevant factors to this consideration include:

   - The treatment processes which the proposed solutions employ and materials they treat;

   - the amount of contaminated materials that will be destroyed or treated;

   - the degree of expected reduction in toxicity, mobility or volume;

- o the degree to which the treatment is irreversible; and

- o the residuals that will remain following treatment, considering the persistence, toxicity, mobility, and propensity for bio-accumulation of such hazardous substances and their constituents.

3. <u>Short-term Effectiveness</u>

The short-term effectiveness of an alternative is assessed including a consideration of the following:

- o Magnitude of reduction of existing risks; and

- o short-term risks that might be posed to the community, workers, or the environment during the implementation of an alternative including potential threats to human health or the environment associated with excavation, transportation, or redisposal or containment.

4. <u>Long-term Effectiveness and Permanence</u>

Each alternative is assessed for the long-term effectiveness and permanence it affords along with the degree of certainty that the remedy will prove successful. Factors considered include:

- o Magnitude of residual risks in terms of amounts and concentrations of wastes remaining following implementation of a remedial action, considering the persistence, toxicity, mobility and propensity for bio-accumulation of such hazardous substances and their constituents;

- o type and degree of long-term management required, including monitoring and operation and maintenance;

- o potential for exposure of human and environmental receptors to remaining waste considering the potential threat to human health and the environment associated with excavation, transportation, redisposal, or containment;

- o long-term reliability of the engineering and institutional controls, including uncertainties associated with the land disposal of untreated wastes and residuals; and

- potential need for replacement of the remedy.

5. Implementability

The ease or difficulty of implementing the alternatives is assessed by considering the following factors:

- Degree of difficulty associated with constructing the solution;
- expected operational reliability of the treatment technology;
- need to coordinate with and obtain necessary approvals and permits (or meet the intent of any permit in the case of Superfund actions);
- availability of necessary equipment and specialists; and
- available capacity and location of needed treatment, storage and disposal services.

6. Costs

The types of costs assessed include the following:

- Capital costs;
- operation and maintenance costs;
- net present value of capital and operation and maintenance cost; and
- potential future remedial action costs.

7. Community Acceptance

This assessment evaluates:

- Components of remedial alternatives that the community supports;
- features of the alternatives about which the community has reservations; and
- elements of the alternatives which the community strongly opposes.

8. <u>State Acceptance</u>

This evaluation includes an assessment of:

- o Components of remedial alternatives that the State supports;
- o features of the alternatives about which the State has reservations; and
- o elements of the alternatives which the State strongly opposes.

9. <u>Overall Protection of Human Health and the Environment</u>

Following the analysis of the remedial options against individual evaluation criteria, the alternatives are assessed from the standpoint of whether they provide adequate protection of human health and the environment.

SARA directs EPA to give preference to solutions that utilize treatment to remove contaminants from the environment. Off-site transport and disposal without treatment is the least preferred option where practicable treatment technologies are available.

6.2.2 Evaluation Summary

The following values were assigned to compare remedial selection criteria:

"+" Alternative should exceed a criterion in comparison to other alternatives.

"." Alternative should meet the selection criterion.

"-" Alternative will not meet a criterion, or will not meet a criterion as well as other alternatives.

The rationale for the ratings assigned each alternative is presented in the following subsections.

6.2.3 Compliance with ARARs

With the exception of the No Action alternative, all alternatives were rated "." because they are designed to comply with ARARs defined in Section 3. The No Action remedy was rated "-"

because it does not meet the closure ARARs and does not effectively address the risk-based remedial objective.

6.2.4 Reduction of Toxicity, Mobility or Volume

The No Action alternative is ranked "-" because it does nothing to reduce toxicity, mobility or volume. The action alternatives differ principally with regard to the reduction in potential toxicity, mobility or volume of their treatment residuals. The Soil Mixing alternative is ranked "-" because the residuals from sludge interaction with the soil matrix (inorganic complexation, orgar c complexation, acid-based reactions, oxidation-reduction, precipitation, ion exchange and adsorption are the physical/chemical actions involved) do not achieve as large a reduction in potential toxicity and mobility as the other alternatives, and because the volume increase is substantially larger. The Stabilization alternative is ranked "." because the physical/chemical treatment process involved more effectively controls the potential residual toxicity and mobility of the residuals, and because the volume of the residuals is smaller than soil mixing. 0 1 1 0 4 0

The biotreatment alternative is ranked "+/." because it further decreases waste toxicity by degrading or removing volatile and semi-volatile waste constituents. Also, while biotreatment results in a reduction in waste volume, the reduction is not as great as for solvent extraction and incineration which are both ranked "+".

Incineration and solvent extraction receive a "+" rating since they are the only alternatives which significantly reduce waste volume as well as essentially destroy all organic chemicals of concern at the site. However, incineration concentrates into an ash most of the metals found in the sludge.

With the exception of the No Action alternative, the treatment provided for the wastes is not readily reversible. This is true for Solvent Extraction and Incineration alternatives with respect to organic constituents which are destroyed. However, for incineration, metals would remain in the ash and may even be in a more soluble form. For Solvent Extraction, metals would be concentrated in the solid phase. Both the Stabilization and Biotreatment alternatives involve stabilization reactions which could be reversed by desorption, biodegradation or dissolution of the waste matrix. Rainfall infiltration and percolation are necessary for these reversal processes, however, and are minimized by the engineered cap. Treatment by mixing with clay-rich soil in the Soil Mixing alternative is more easily reversed, but is also minimized by the engineered cap.

6.2.5 Short-Term Effectiveness

With the exception of the No Action alternative, which is ranked "-", all alternatives effectively reduce the magnitude of existing risks and achieve full protection in two to five years. These risks are defined in Section 2 and the alternatives are designed to specifically address those risks. The time to complete remediation is identified in Section 6.1. The Solvent Extraction and Incineration alternatives would likely result in increased constituent loading to the atmosphere during implementation as compared to other alternatives.

Also, the alternatives differ with regard to risks to the community, workers, or the environment during implementation. All action alternatives involve the risks attendant to construction involving heavy earth work, including risks to workers and community and environmental impacts due to dust and noise. Further, all action alternatives will release volatile organics to some degree as the pond sludge is treated in place or is removed for treatment.

The Soil Mixing and Stabilization alternatives are ranked "+" because these risks are relatively minor and occur over a shorter time period. Biotreatment and Solvent Extraction involve additional handling with process equipment, and are thus ranked ".". The Incineration alternative is ranked "-" because of 1) increased materials handling requirements, 2) unit processes involving high temperature combustion, rotary machinery and periodic vessel entry, and 3) longer period of operation.

6.2.6 Long-Term Effectiveness and Permanence

Except for the No Action alternative, which is ranked "-", the only difference among the alternatives relates to the long-term risks from leaching of waste constituents and exposure to residual waste. The Soil Mixing alternative is ranked "-" because waste constituents are less effectively immobilized than in other alternatives and this alternative results in a larger residual volume relative to other alternatives. The Stabilization alternative is ranked "./-" because the degree of mobility reduction for the Stabilization alternative is probably greater than for Soil Mixing. More frequent monitoring of ground water and stormwater discharge is needed for these alternatives because of constituent mobility concerns, although institutional controls will insure that no water supply wells are screened in the upper water bearing zone, downgradient of the site.

The Biotreatment alternative is ranked "+" (even though it is not as effective as Solvent Extraction and Incineration), because this process would degrade or remove the more mobile compounds contained within the waste matrix, that is, the volatiles and semi-volatiles. Certain compounds, such as PCBs, would be more difficult to degrade. Even if not degraded, however, the potential for mobility of these compounds would be reduced through elimination of the more mobile constituents in the waste matrix. This result enhances the long-term effectiveness of stabilization of the biological residue since the more mobile constituents, which are more difficult to stabilize, would be removed from the matrix prior to stabilization of the biological residue.

Incineration and Solvent Extraction are ranked "+" and are the only alternatives which destroy essentially all of the organic chemicals and result in the least residual volume. However, incineration concentrates most of the metals into the ash.

6.2.7 Implementability

The No Action alternative would be the easiest to implement and is rated "+". Among the remaining alternatives, the Soil Mixing and Stabilization alternatives are readily implementable. They are ranked "+" because they have been frequently used to close impoundments, they are mechanically simple and readily adaptable to field conditions, and they do not require special equipment or off-site facilities. The Biotreatment alternative is ranked "." because it will probably require the construction of specialized treatment tanks to accommodate the special mixing and sludge handling needs of that alternative. Still, Biotreatment is a demonstrated technology, is adaptable to unexpected waste characteristics and does not require operators with a high level of training. By contrast, the Solvent Extraction and Incineration alternatives are ranked "-" because these technologies are mechanically complex, require highly specialized equipment and operators, and may require an approved off-site disposal facility for ash. In addition, Solvent Extraction may be difficult to adapt in the field.

Demonstrated effectiveness is not an identified factor of the criterion of implementability, but is a critical consideration at this site. The Soil Mixing technology has been implemented full-scale on the closure of impoundments. Some bench studies have already been conducted to determine effectiveness of Stabilization, Biotreatment and Solvent Extraction for the site.

Additional stabilization and biological treatment studies are on-going. Solvent Extraction has only been tested at one site which totaled only 4,000 cubic yards, but solvent extraction processes are widely used in manufacturing industries. The facility that would be needed for solvent extraction at this site would require special materials handling capabilities in order to address the heterogeneous nature of this waste. Such a system has not been field tested to date. Incineration is widely used for the destruction of solid waste, but achieving 99.9999% destruction of PCBs may be more difficult because the waste is heterogeneous (with a physical texture that includes liquids, tires, soils, construction debris and drum carcasses, and a fuel value that ranges from 11,000 BTU/lb to less than 1,000 BTU/lb).

With adequate feed preparation, the widely differing physical characteristics of the waste materials are not expected to impact treatment effectiveness, but the implementation of operational systems for waste handling and treatment is a concern. A wide range of waste characteristics should pose no problem for Soil Mixing and Stabilization, as much of that work will be accomplished with equipment which has proven adaptable to changing field conditions. Aqueous biotreatment should be able to deal with varying waste characteristics. Adherence of residual solids to the treatment tanks could necessitate field modification of the treatment system. Solvent Extraction and Incineration alternatives are each more complicated and are thus more vulnerable to temporary operational difficulties.

There is also a concern about the availability of needed equipment and specialists. The Soil Mixing alternative requires only conventional construction equipment and equipment operators. The same is generally true for in-situ Stabilization, although proprietary mixing equipment might be employed. Stabilization in batches outside of the main pond and Biotreatment would involve mixing and materials handling systems that are custom tailored for this kind of work. These are readily available or easily adapted and a high degree of skill is not required to operate them. Suitable Solvent Extraction equipment would have to be assembled, and would require a major mobilization effort involving the interconnection of several mobile modules to form a facility similar to that shown in Figure 6-7. Similarly, the Incineration alternative would require the construction of an incinerator on-site.

Another concern regarding incineration is that in a rotary kiln, temperature and excess air will be relatively low, but in the afterburner both high temperatures and high excess air exist. Limited test burn data show about 200 ppm NO_x in rotary kiln stack gases (<u>Permit Writer's Guide to Test Burn Data, Hazardous Waste Incineration</u>, EPA/625/6-86/012). Moreover, these levels of NO_x are difficult to reduce. Rotary kiln incinerators cannot be operated or redesigned to significantly reduce the NO_x generation rates, and NO_x control would be very costly.

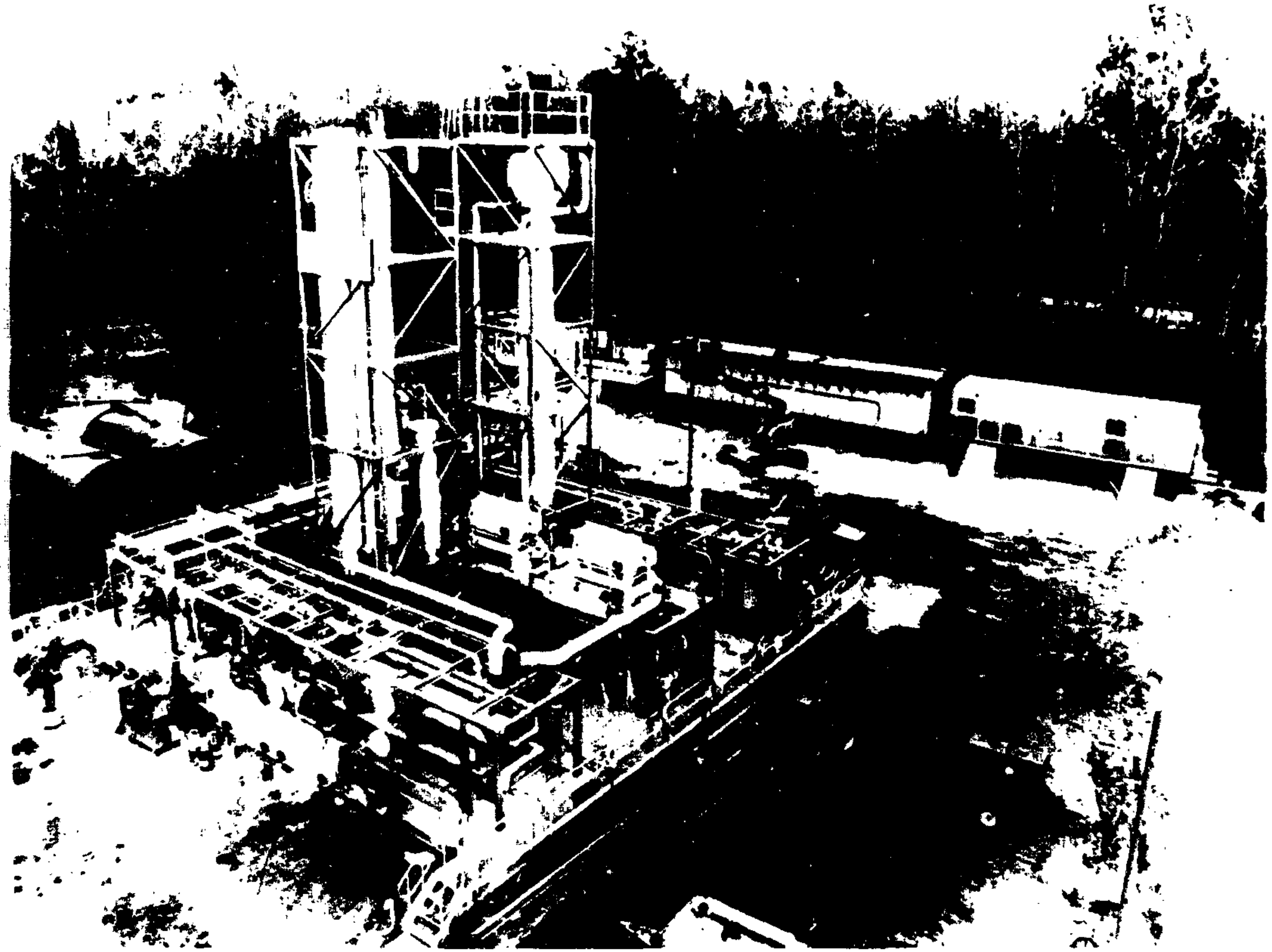

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FIGURE 6-7
SOLVENT EXTRACTION FACILITY

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6.2.8 Cost

Table 6-1 summarizes the total cost of the alternatives as developed in detail in Section 6.3 and in Appendix G. Costs are presented as capital, post closure O & M and ground water monitoring, and total cost. The No Action alternative is of course the least costly alternative and is ranked "+". Solvent Extraction and Incineration are the most costly alternatives and are ranked "-". The middle range of costs includes the Soil Mixing, Stabilization and Biotreatment alternatives, and these are ranked ".".

6.2.9 Overall Protection of Human Health, Environment

The No Action alternative is ranked "-" because the potential exposures by direct contact to waste and of bank failure and inundation of the wastes are not controlled. All remaining alternatives prevent these exposures but differ in the degree they ensure long-term effectiveness and permancence and achieve short-term effectiveness. Therefore, Soil Mixing is ranked "./-" because it results in the greatest volume of waste residual without significant treatment. Stabilization is ranked "." because it decreases the leachability of the waste without decreasing waste toxicity. Biotreatment is ranked "+" because this alternative degrades most toxic waste constituents as well as reducing waste mobility. Solvent Extraction is ranked "+" because all contaminants are destroyed to the maximum extent possible. Incineration also achieves similar destruction, but is rated "+/." because it is less effective in the short-term.

6.3 Cost

6.3.1 Total Cost

A cost was systematically estimated for each alternative from a foundation of common unit costs. Estimated costs were developed sequentially as follows:

1. Unit Costs - unit costs for remediation activities common in the region. Example: On-Site Soil Handling, $2.00/yd^3.
2. Options Costs - costs for treatment and containment options to be incorporated into assembled alternatives. Based on concept designs in Section 6.1.
3. Alternatives Costs - estimated total cost for each alternative. Based on concept designs in Section 6.1. Contains unit costs, derived unit costs and options costs. Includes contingencies, operating and post-closure monitoring costs.

Tables 6-2 through 6-7 summarize the estimated total cost for each of the six proposed alternatives.

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TABLE 6-1
PRESENT VALUE COST SUMMARY FOR ALTERNATIVES

COST ITEM	ALT. A - NO ACTION ($MIL)	ALT. B - SOIL MIXING ($MIL)	ALT. C - STABI-LIZATION ($MIL)	ALT. D - BIO-TREATMENT ($MIL)	ALT. E - SOLVENT EXTRACTION ($MIL)	ALT. F - INCINERATION ($MIL)
Estimated Capital Cost [a]	0.09	19.86	17.99	27.48	35.65	38.75
Total Post-Closure Cost	0.46	0.99	0.88	0.86	0.86	0.86
PV Post-Closure Cost [b]	0.28	0.56	0.47	0.47	0.47	0.47
Total Alternative Cost	0.55	20.86	18.86	28.35	36.51	39.61
PV Alternative Cost [b]	0.37	20.22	18.47	27.96	36.12	39.22

[a] This cost represents present value assuming after-tax i = inflation
[b] 30-year present value with i = 5% and inflation = 0

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TABLE 6-2

ESTIMATED TOTAL COST
ALTERNATIVE A - NO ACTION

The estimated total cost is the sum of capital cost, the cost of 30 years of annual maintenance and seven monitoring events (1, 3, 6, 10, 15, 20 and 30 years after closure). All costs are early 1988, except as noted. "Total" costs assume present value after i = inflation. "Present value" costs assumes i = 5%

	Quantity	Units	Unit Cost	Cost	Notes
CAPITAL COST					
Plug existing monitor wells	12.00	each	$1,500	$18,000	
Install new monitor wells	12.00	each	$3,500	42,000	
Subtotal				$60,000	
Contractor Overhead, Profit, Bonds, Engineering & Construction Surveillance			X	1.20	
Contingency			X	1.25	
ESTIMATED CAPITAL COST				$90,000	
30-YEAR POST-CLOSURE MONITORING & MAINTENANCE					
Ground water monitoring	7	events	$36,200	$253,400	
Stormwater monitoring	7	events	$7,600	$53,200	
Subtotal				$306,600	
Contingency			X	1.25	
Engineering & Construction Surveillance			X	1.20	
TOTAL POST-CLOSURE COSTS				$460,000	Rounded
Present Value Post-Closure Costs				$280,000	
TOTAL ESTIMATED ALTERNATIVE COST				$650,000	
Present Value Estimated Alternative Cost				$370,000	

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TABLE 6-3

ESTIMATED TOTAL COST
ALTERNATIVE 8 - SOIL MIXING

The estimated total cost is the sum of capital cost, the cost of 30 years of annual maintenance and seven monitoring events (1, 3, 6, 10, 15, 20 and 30 years after closure). All costs are early 1988, except as noted. "Total" costs assume present value after i = inflation. "Present value" costs assumes i = 5%

	Quantity	Units	Unit Cost	Cost	Notes
CAPITAL COST					
Mobilization/Demobilization				$50,000	Allowance
Haul roads	2,500	ft	$9.70	24,000	Rounded
Maintenance roads	5,000	ft	$15.40	77,000	
Run-on / run-off control	5,000	lf	$5.10	26,000	3' berm + ditch (rounded)
Drum handling				500,000	Intact drums
Liner				4,781,000	
Mix sludge with soil				2,008,000	
Supplemental pond fill				0	No fill needed
Cap pond				3,842,000	
Site utilities & facilities				1,108,000	
Restore disturbed areas (topsoil and revegetation)	4.00	ac	$14,500	58,000	
Jetty system				490,000	
Plug existing monitor wells	12.00	each	$1,500	18,000	
Install new monitor wells	12.00	each	$3,500	42,000	
Fencing	10,000	ft	$7.40	74,000	
Subtotal				$13,108,000	
Contractor Overhead, Profit, Bonds, Engineering & Construction Surveillance			X	1.20	
Contingency			X	1.25	
ESTIMATED CAPITAL COST				$19,662,000	
30-YEAR POST-CLOSURE MONITORING & MAINTENANCE					
Ground water monitoring	7	events	$36,200	$253,400	
Stormwater monitoring	7	events	$7,600	$53,200	
Cap maintenance	27	acre-yr	$125	101,000	
Jetty system maintenance	1	year	$1,000	30,000	Allowance
Site maintenance	100	acre-yr	$75	225,000	
Subtotal				$662,600	
Contingency			X	1.25	
Engineering & Construction Surveillance			X	1.20	
TOTAL POST-CLOSURE COSTS				$994,000	Rounded
Present Value Post-Closure Costs				$554,000	
TOTAL ESTIMATED ALTERNATIVE COST				$20,656,000	
Present Value Estimated Alternative Cost				$20,216,000	

TABLE 6-4

ESTIMATED TOTAL COST
ALTERNATIVE C - STABILIZATION

The estimated total cost is the sum of capital cost, the cost of 30 years of annual maintenance and five monitoring events (1, 3, 10, 20 and 30 years after closure). All costs are early 1988, except as noted. "Total" costs assume present value after i = inflation. "Present value" costs assumes i = 5%

	Quantity	Units	Unit Cost	Cost	Notes
CAPITAL COST					
Mobilization/Demobilization				$50,000	Allowance
Haul roads	2,500	ft	$9.70	24,000	Rounded
Maintenance roads	5,000	ft	$15.40	77,000	
Run-on / run-off control	5,000	lf	$5.10	26,000	3' berm + ditch (rounded)
Drum handling				500,000	Intact drums
Liner				704,000	
Stabilize sludge	44,000	cy	$85.00	3,740,000	
Supplemental pond fill	147,000	cy	$4.50	662,000	
Cap pond				3,842,000	
Site utilities & facilities				1,688,000	
Restore disturbed areas (topsoil and revegetation)	4.00	ac	$14,500	58,000	
Jetty system				490,000	
Plug existing monitor wells	12.00	each	$1,500	18,000	
Install new monitor wells	12.00	each	$3,500	42,000	
Fencing	10,000	ft	$7.40	74,000	
Subtotal				$11,995,000	
Contractor Overhead, Profit, Bonds,					
Engineering & Construction Surveillance			X	1.20	
Contingency			X	1.25	
ESTIMATED CAPITAL COST				$17,993,000	
30-YEAR POST-CLOSURE MONITORING & MAINTENANCE					
Ground water monitoring	5	events	$36,200	$181,000	
Stormwater monitoring	5	events	$7,600	$38,000	
Cap maintenance	27	acre-yr	$125	101,000	
Jetty system maintenance	1	year	$1,000	30,000	Allowance
Site maintenance	100	acre-yr	$75	225,000	
Subtotal				$575,000	
Contingency			X	1.25	
Engineering & Construction Surveillance			X	1.20	
TOTAL POST-CLOSURE COSTS				$863,000	Rounded
Present Value Post-Closure Costs				$473,000	
TOTAL ESTIMATED ALTERNATIVE COST				$18,856,000	
Present Value Estimated Alternative Cost				$18,466,000	

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TABLE 6-5

ESTIMATED TOTAL COST
ALTERNATIVE D - BIOTREATMENT

This estimated total cost is the sum of capital cost, the cost of 30 years of annual maintenance and five monitoring events (1, 3, 10, 20 and 30 years after closure). All costs are early 1988, except as noted. "Total" costs assume present value after i = inflation. "Present value" costs assumes i = 5%

	Quantity	Units	Unit Cost	Cost	Notes
CAPITAL COST					
Mobilization/Demobilization				$60,000	Allowance
Haul roads	2,500	ft	$9.70	24,000	Rounded
Maintenance roads	5,000	ft	$15.40	77,000	
Run-on / run-off control	5,000	lf	$5.10	26,000	3' berm + ditch (rounded)
Drum handling				500,000	Intact drums
Biotreatment				9,815,000	
Liner				534,000	
Supplemental pond fill	161,000	cy	$4.50	725,000	
Cap pond				3,842,000	
Site utilities & facilities				2,047,000	
Restore disturbed areas (topsoil and revegetation)	4.00	ac	$14,500	58,000	
Jetty system				490,000	
Plug existing monitor wells	12.00	each	$1,500	18,000	
Install new monitor wells	12.00	each	$3,500	42,000	
Fencing	10,000	ft	$7.40	74,000	
Subtotal				$18,322,000	
Contractor Overhead, Profit, Bonds, Engineering & Construction Surveillance			X	1.20	
Contingency			X	1.25	
ESTIMATED CAPITAL COST				$27,483,000	
30-YEAR POST-CLOSURE MONITORING & MAINTENANCE					
Ground water monitoring	5	events	$36,200	$181,000	
Stormwater monitoring	5	events	$7,600	$38,000	
Cap maintenance	27	acre-yr	$125	101,000	
Jetty system maintenance	1	year	$1,000	30,000	Allowance
Site maintenance	100	acre-yr	$75	225,000	
Subtotal				$575,000	
Contingency			X	1.25	
Engineering & Construction Surveillance			X	1.20	
TOTAL POST-CLOSURE COSTS				$863,000	Rounded
Present Value Post-Closure Costs				$473,000	
TOTAL ESTIMATED ALTERNATIVE COST				$28,346,000	
Present Value Estimated Alternative Cost				$27,956,000	

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TABLE 6-6

ESTIMATED TOTAL COST
ALTERNATIVE E - SOLVENT EXTRACTION

The estimated total cost is the sum of capital cost, the cost of 30 years of annual maintenance and five monitoring events (1, 3, 10, 20 and 30 years after closure). All costs are early 1988, except as noted. "Total" costs assume present value after i = inflation. "Present value" costs assumes i = 5%

	Quantity	Units	Unit Cost	Cost	Notes
CAPITAL COST					
Mob/Demob, exclusive of Solv. Extr.				$60,000	Allowance
Haul roads	2,500	ft	$9.70	24,000	Rounded
Maintenance roads	5,000	ft	$15.40	77,000	
Run-on / run-off control	5,000	lf	$5.10	26,000	3' berm + ditch (rounded)
Drum handling				110,000	Intact drums
Isolate sludge				1,168,000	
Solvent extract/Incinerate/Stabilize				14,199,000	
Scrubber ash to main pond	420	cy	$4.50	2,000	
Supplemental pond fill	177,000	cy	$4.50	797,000	
Cap pond				3,842,000	
Site utilities & facilities				2,736,000	
Restore disturbed areas (topsoil and revegetation)	4.00	ac	$14,500	58,000	
Jetty system				490,000	
Plug existing monitor wells	12.00	each	$1,500	18,000	
Install new monitor wells	12.00	each	$3,500	42,000	
Fencing	10,000	ft	$7.40	74,000	
Fire protection				50,000	
Subtotal				$23,763,000	
Contractor Overhead, Profit, Bonds, Engineering & Construction Surveillance			X	1.20	
Contingency			X	1.25	
ESTIMATED CAPITAL COST				$35,645,000	
30-YEAR POST-CLOSURE MONITORING & MAINTENANCE					
Ground water monitoring	5	events	$36,200	$181,000	
Stormwater monitoring	5	events	$7,600	$38,000	
Cap maintenance	27	acre-yr	$125	101,000	
Jetty system maintenance	1	year	$1,000	30,000	Allowance
Site maintenance	100	acre-yr	$75	225,000	
Subtotal				$575,000	
Contingency			X	1.25	
Engineering & Construction Surveillance			X	1.20	
TOTAL POST-CLOSURE COSTS				$863,000	Rounded
Present Value Post-Closure Costs				$473,000	
TOTAL ESTIMATED ALTERNATIVE COST				$36,508,000	
Present Value Estimated Alternative Cost				$36,118,000	

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TABLE 6-7

ESTIMATED TOTAL COST
ALTERNATIVE F - INCINERATION

The estimated total cost is the sum of capital cost, the cost of 30 years of annual maintenance and five monitoring events (1, 3, 10, 20 and 30 years after closure). All costs are early 1988, except as noted. "Total" costs assume present value after i = inflation. "Present value" costs assumes i = 5%

	Quantity	Units	Unit Cost	Cost	Notes
CAPITAL COST					
Mobilization/Demobilization				$50,000	Allowance
Haul roads	2,500	ft	$9.70	24,000	Rounded
Maintenance roads	5,000	ft	$15.40	77,000	
Run-on / run-off control	5,000	lf	$5.10	26,000	3' berm + ditch (rounded
Drum handling				110,000	Intact drums
Isolate sludge				1,168,000	
Incineration				12,810,000	
Scrubber ash to main pond	420	cy	$4.50	2,000	
Off-site incinerator ash disposal	12,000	cy	$187	2,239,000	
Supplemental pond fill	185,000	cy	$4.50	833,000	
Cap pond				3,842,000	
Site utilities & facilities				3,880,000	
Restore disturbed areas (topsoil and revegetation)	8.00	ac	$14,500	116,000	
Jetty system				490,000	
Plug existing monitor wells	12.00	each	$1,500	18,000	
Install new monitor wells	12.00	each	$3,500	42,000	
Fencing	10,000	ft	$7.40	74,000	
Fire protection system				50,000	
Subtotal				$25,831,000	
Contractor Overhead, Profit, Bonds, Engineering & Construction Surveillance			X	1.20	
Contingency			X	1.25	
ESTIMATED CAPITAL COST				$38,747,000	
30-YEAR POST-CLOSURE MONITORING & MAINTENANCE					
Ground water monitoring	5	events	$36,200	$181,000	
Stormwater monitoring	5	events	$7,600	$38,000	
Cap maintenance	27	acre-yr	$125	101,000	
Jetty system maintenance	1	year	$1,000	30,000	Allowance
Site maintenance	100	acre-yr	$75	225,000	
Subtotal				$575,000	
Contingency			X	1.25	
Engineering & Construction Surveillance			X	1.20	
TOTAL POST-CLOSURE COSTS				$863,000	Rounded
Present Value Post-Closure Costs				$473,000	
TOTAL ESTIMATED ALTERNATIVE COST				$39,610,000	
Present Value Estimated Alternative Cost				$39,220,000	

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Appendix G contains the development of the estimated total cost for each alternative. This appendix includes a summary table, alternatives' costs, options' costs, derived unit costs and unit costs. Special concerns about present worth analysis of costs and about the cost of incineration are discussed in the following paragraphs.

For this Feasibility Study the following present worth assumptions were used:

- o term = 30 years
- o interest rate = 0
- o inflation = after-tax interest rate

The 30 year term is consistent with the post-closure care period prescribed under the RCRA program. Historically in this country inflation is approximately equal to interest paid on certificates of deposit after corporate taxes are deducted. A PRP group which funds the remediation and long-term maintenance of a Superfund site typically creates a sinking fund or trust fund at the beginning or end of site remediation. This sinking fund is typically invested in insured securities, and is calculated to be sufficient to pay for the annual O&M costs for a designated period of time. Since a PRP group can not have non-profit status under the current tax law, it must pay taxes on the interest earned.

Since inflation is a very real economic phenomenon, a PRP group must set aside funds to provide for future increases in annual O&M costs. Historically, interest on invested securities is typically greater than inflation by one-third to one-half. Current corporate tax rates are 34%. These taxes are either paid by each member company or by the PRP group directly. After taxes are deducted from interest earned, the net interest earned on the invested funds approximately offsets the increased annual costs due to inflation. On this basis, i = 0 in the present worth formula. Following these assumptions, the 30-year present worth of an O & M cost of $1/year is $30.

Alternately, if one were to use the Federal government's guidelines for calculating present value for 30 years using 8% interest and 0% inflation, the present worth of a $1/year expenditure for 30 years is $11.26. As this illustrates, neglecting inflation will cause annual O & M costs to be understated, possibly resulting in the selection of a remedial plan that has lower capital or first year costs and higher annual or reoccurring O & M costs.

For clarity, the cost calculations and summaries are presented both ways.

6.3.2 Sensitivity Analysis

Capital Cost Sensitivity Analysis

The cost estimates presented in the FS are to represent +50%/-33% accuracy, so these are the sensitivity limits chosen. Table 6-8 shows that while the relative cost rankings are not altered by the changes in capital costs, the absolute dollar increases between alternatives are significant. For example, if the estimated capital cost escalates 50%, the Stabilization alternative increases $9.0 million while the Incineration alternative increases $19.4 million. The higher the initial estimated alternative cost, the greater the absolute cost increases when the higher estimating accuracy percentage is applied.

O & M Cost Sensitivity Analysis

The costs were varied within the same +50%/-33% estimate accuracy range as the capital costs. Table 6-9 reflects very little total cost sensitivity to O&M cost variability since O&M represents a small cost relative to the overall total cost.

Discount Rate Sensitivity Analysis

The discount rate utilized for the present worth calculations was varied in a range from 3% to 10%. Table 6-10 reflects the fact that the total cost is not sensitive to this range of discount rates.

Sludge Volume Sensitivity Analysis

Since there is uncertainty about the total volume of sludge to be handled, a reasonable sensitivity range of volumes was determined to be from a slightly less volume than currently estimated to twice the volume currently estimated. Table 6-11 shows that the total cost of the Solvent Extraction and Incineration alternatives are more sensitive to pond sludge volume increases than the other alternatives. For example, if the sludge volume is doubled, the Stabilization alternative total cost increases $5.5 million (29.1%) while the Incineration alternative increases $19.9 million (50.3%). The higher unit costs for the actual treatment phase for Solvent Extraction and Incineration alternatives causes them to be more sensitive to total cost changes caused by sludge volume changes.

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TABLE 6-6
CAPITAL COST SENSITIVITY ANALYSIS

TABLE 6-1 COST CHANGE [a]	ALT. A - NO ACTION ($MIL)	ALT. B - SOIL MIXING ($MIL)	ALT. C - STABI- LIZATION ($MIL)	ALT. D - BIO- TREATMENT ($MIL)	ALT. E - SOLVENT EXTRACTION ($MIL)	ALT. F - INCINERATION ($MIL)
Total [b]	$0.6	$20.7	$18.9	$28.3	$36.5	$39.6
50%	$0.6	$30.5	$27.9	$42.1	$54.3	$59.0
25%	$0.6	$26.2	$23.9	$36.0	$46.5	$50.5
0%	$0.6	$20.7	$18.9	$28.3	$36.5	$39.6
-20%	$0.5	$16.7	$15.3	$22.8	$29.4	$31.9
-33%	$0.5	$14.2	$12.9	$19.3	$24.7	$26.8

[a] The Table 6-1 present value total cost for each alternative
for the percent change shown in capital costs
[b] After-tax 1 = inflation

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TABLE 6-9
O&M COST SENSITIVITY ANALYSIS

TABLE 6-1 COST CHANGE [a]	ALT. A - NO ACTION ($MIL)	ALT. B - SOIL MIXING ($MIL)	ALT. C - STABI-LIZATION ($MIL)	ALT. D - BIO-TREATMENT ($MIL)	ALT. E - SOLVENT EXTRACTION ($MIL)	ALT. F - INCINERATION ($MIL)
Total [b]	$0.6	$20.7	$18.9	$28.3	$36.5	$39.6
50%	$0.8	$21.2	$19.3	$28.8	$36.9	$40.0
25%	$0.7	$20.9	$19.1	$28.6	$36.7	$39.8
0%	$0.6	$20.7	$18.9	$28.3	$36.5	$39.6
-20%	$0.5	$20.5	$18.7	$28.2	$36.3	$39.4
-33%	$0.4	$20.3	$18.6	$28.1	$36.2	$39.3

[a] The Table 6-1 present value total cost for each alternative for the percent change shown in O&M costs
[b] After-tax i = inflation

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TABLE 6-10
PRESENT WORTH DISCOUNT RATE SENSITIVITY ANALYSIS

DISCOUNT RATE [a] (%)	ALT. A - NO ACTION ($MIL)	ALT. B - SOIL MIXING ($MIL)	ALT. C - STABI-LIZATION ($MIL)	ALT. D - BIO-TREATMENT ($MIL)	ALT. E - SOLVENT EXTRACTION ($MIL)	ALT. F - INCINERATION ($MIL)
Total [b]	$0.4	$20.2	$18.5	$28.0	$36.1	$39.2
3%	$0.4	$20.3	$18.6	$28.1	$36.2	$39.3
4%	$0.4	$20.3	$18.5	$28.0	$36.2	$39.3
5%	$0.4	$20.2	$18.5	$28.0	$36.1	$39.2
6%	$0.3	$20.2	$18.4	$27.9	$36.1	$39.2
7%	$0.3	$20.1	$18.4	$27.9	$36.0	$39.1
8%	$0.3	$20.1	$18.4	$27.8	$36.0	$39.1
9%	$0.3	$20.1	$18.3	$27.8	$36.0	$39.1
10%	$0.3	$20.0	$18.3	$27.8	$36.0	$39.1

[a] A range of discount rates is used to calculate present worth total cost for each alternative in Table 6-2
[b] i = 5%

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TABLE 6-11
SLUDGE VOLUME SENSITIVITY ANALYSIS

POND SLUDGE VOLUME [a] (YD3)	ALT. A - NO ACTION ($MIL)	ALT. B - SOIL MIXING ($MIL)	ALT. C - STABI-LIZATION ($MIL)	ALT. D - BIO-TREATMENT ($MIL)	ALT. E - SOLVENT EXTRACTION ($MIL)	ALT. F - INCINERATION ($MIL)
Total [b]	$0.6	$20.7	$18.9	$28.3	$36.5	$39.6
20,000	$0.6	$18.2	$17.0	$26.3	$32.6	$32.7
30,000	$0.6	$20.7	$18.9	$28.3	$36.5	$39.6
40,000	$0.6	$22.1	$20.7	$32.4	$40.5	$46.1
50,000	$0.6	$23.5	$22.6	$35.9	$45.1	$53.2
60,000	$0.6	$24.8	$24.4	$37.8	$49.2	$59.5

[a] Pond sludge and floating oil and emulsion volume (30,000 cy) is varied, while oily surface soil, evaporation system sludge and affected soil under the pond volume(total 14,000 cy) are held constant.
[b] After-tax i = inflation

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6.4 Summary of Comparative Analysis

Table 6-12 contains a summary of the ranking of alternative performed in Section 6.2. In terms of the remedial objectives, all alternatives except No Action satisfy the regulatory objectives through compliance with ARARs. Similarly, all alternatives except No Action satisfy the risk-based objectives and, when implemented, would be fully protective of human health and the environment for as long as maintenance continues. In terms of long-term effectiveness, as well as toxicity, mobility and volume reduction, No Action and Soil Mixing are the least effective remedies. Stabilization is slightly more effective because there is greater reduction of mobility. Biotreatment is a relatively permanent remedy in that the only constituent of concern that will remain after treatment is PCBs. PCBs are very immobile due to an extremely high soil partition coefficient and low water solubility, and mobility is further controlled by a cap which would reduce any infiltration. Solvent Extraction and Incineration result in the greatest toxicity, mobility and volume reduction, thereby resulting in the greatest possible long-term effectiveness and permanence.

Among the other criteria considered, the ranking varied among the alternatives with costs generally increasing from alternative A through F (ranging from $400,000 to $39,200,000 on a present value basis). The more costly alternatives (especially Incineration and Solvent Extraction), while technically achievable, present special implementability problems and generally take longer to implement, decreasing their short-term effectiveness.

TABLE 6-12

Summary Ranking of Alternatives

	Compliance With ARARs	Toxicity Mobility or Volume Reduction	Short-Term Effectiveness	Long-Term Effectiveness, Permanence
A No Action	-	-	-	-
B Soil Mixing	.	-	+	-
C Stabilization	.	.	+	./-
D Biotreatment	.	+/.	.	+
E Solvent Extraction	.	+	.	+
F Incineration	.	+	-	+

	Implementability	Cost	Overall Protection of Human Health, Environment
A No Action	+	-	-
B Soil Mixing	+	.	./-
C Stabilization	+	.	.
D Biotreatment	.	.	+
E Solvent Extraction	-	-	+
F Incineration	-	-	+/.

NOTES:

"+" Alternative should exceed a criterion in comparison to other alternatives.
"." Alternative should meet the selection criterion.
"-" Alternative will not meet a criterion, or will not meet a criterion as well as other alternatives.

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